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# PE



Eclipses at Pine River

Notes on the Nature of Light

Moon Madness

Stars for August

# The Editors Note

EDITORIALLY, we kept our fingers crossed in case the eclipse might be generally clouded out and leave us with little news of the event to be reported in this issue. Practically, we had to print two thirds of this August number before the end of June, to insure its completion on time after our return from the eclipse region.

Actually, although we were completely clouded out, along with a score of astronomers and physicists assembled under Lt. Comdr. Donald H. Menzel at Bredenbury, we have now at hand a large amount of material on both the partial and total phases. While we can only begin our coverage of the eclipse in this number, in September we shall try to accede to the requests of readers like Stanley Rudin, of Mount Hope, W. Va., who writes:

"We 'stay-at-homes' who didn't have a chance to view the eclipse would be very glad if you would run a long and well-illustrated article about it. The newspaper accounts have been rather patchy, so **Sky and Telescope** is, for many of us, the only source of information. So please try to outdo yourselves this time."

When we think of how much better Mr. Rudin's view of the eclipse was than ours up there in Saskatchewan . . . .

CONCENTRATION on this eclipse caused us to overlook another which should have been announced in our May issue. It was an 87 per cent eclipse of the moon on June 25-26, visible in the Pacific and Indian Oceans, Asia, Australia, and in the regions where most of the fighting now continues. An Associated Press dispatch reports that three American destroyers were being attacked that night by a dozen enemy planes. Bright moonlight made the surface vessels easy targets, but when the partial eclipse darkened the moon's light the attack was successfully repulsed.

Meanwhile, Pfc. William W. Thorp, of Boston, now on Okinawa, was concerned with sporadic air attacks while observing the partial eclipse. The next day he made a series of sketches from memory, showing that at midnight, Okinawa time, the eclipse reached its maximum, when "it looked like a dark ball with an icecap directly on top."

"During the early stages," writes Private Thorp, "there was a wide band, or halo, surrounding the moon; this crept closer to the moon, finally disappearing when the surface was half shadowed. The darkened part of the moon began to show an outline, faintly and then more clearly as the shadow moved upwards. At the height, there was no halo, and the outline of the moon was quite clear. Scattered clouds were in evidence, but not heavy enough to obliterate vision. Smoke from screening blew across with varying intensity, but it only gave a foglike effect."


# Sky and TELESCOPE



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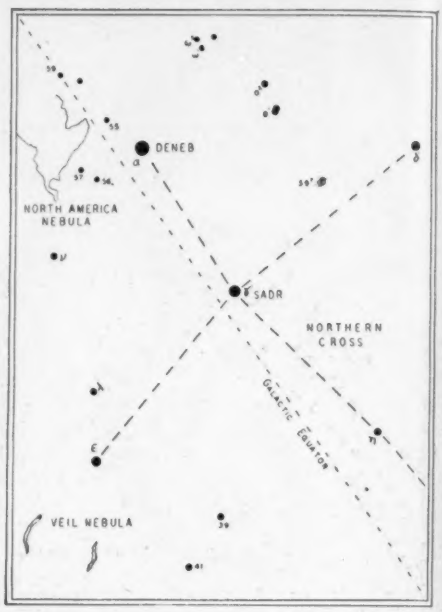
## In Focus

EXTENDING very nearly down the long arm of the Northern Cross is the galactic equator, the celestial circle which divides the Milky Way into two parts, and from which galactic latitude is reckoned, just as latitude is measured from the equator on the earth.

In any photographs of the regions along the galactic equator, we expect to find much larger concentrations of stars and interstellar dust than in the regions toward the galactic poles, where we are looking out through the thinnest parts of our galaxy. This month's back cover shows one of the most beautiful parts of the Milky Way, striking to the naked eye and containing many beautiful nebulae revealed best on long-exposure photographs.

In the upper left corner appears the North America nebula, which was reproduced on a much larger scale on the back cover last month. Part of the Northern Cross in Cygnus, as well as a number of the fainter stars in the region, may be identified from the accompanying diagram.

The Veil nebulae, sometimes called the Larger and Smaller Network nebulae, appear at the lower left. NGC 6992 is at the extreme left, and NGC 6960 is to its right. Fainter nebulosity is believed to connect these two into a complete circlet or wreath.





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**COVER:** A series of photographs of the July 9th eclipse of the sun, taken by members of the Milwaukee Astronomical Society stationed near Pine River, Man. Approximately five minutes in time separates the exposures, which precede totality starting from the lower left (east) side of the picture, and follow totality to the upper right (west) side. The original picture contains three more exposures showing the end of the eclipse.


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**BACK COVER:** The Milky Way in the Cygnus region, a portion of Plate 17 of the Ross-Calvert **Atlas of the Northern Milky Way.** Photo courtesy University of Chicago Press. The photograph was taken by Frank E. Ross, at Flagstaff, Ariz., October 13, 1930, exposure 3 hours, using a 5-inch, f/7 Ross-Fecker camera, now the property of Mount Wilson Observatory.


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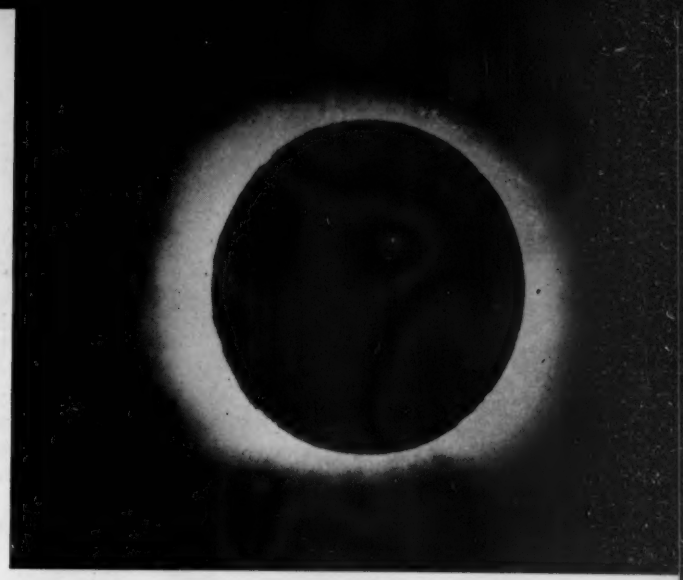
# ALONG THE CENTRAL LINE

*Brief highlights from the path of totality are presented here. More complete accounts from the many observers, and more pictures, will appear in September.*



**The corona's shape was typical of minimum solar activity. Photo by Milwaukee Astronomical Society.**

IN THE Land of Shining Mountains, Butte was the first large community to be struck by the moon's shadow, and there thousands of residents climbed to the summits of surrounding hills to watch totality just 14 minutes after sunrise.

There also were several groups of visiting amateur astronomers, among them young Warren Hollister, who flew up from Los Angeles entirely on his own. He is sure this sunrise spectacle "would be unsurpassed in beauty even by a noonday eclipse."

From New York City came three members of the Amateur Astronomers Association, in a Lockheed experimental plane provided by the Sperry Gyroscope Company. They set up a 10-foot camera and considerable still and motion picture equipment three miles south of Butte, overlooking the Basin Creek valley. At totality the sky was entirely clear except for some clouds low in the northeast. By telephone an hour later, Peter Leavens could hardly restrain himself as he reported:

"Simply unforgettable was the sudden descending approach of the moon's shadow, like some perfectly colossal squall cloud at dusk which spread over the land in a few seconds. Seen over the expanse of the snow-capped mountains still shining outside the shadow path, the effect was literally fantastic."

ELEVEN MINUTES of clear sky brought nearly complete success to observers at Malta, Mont., where 125 persons motored before sunrise to a knoll on the prairie 15 miles to the south of that town. Visual observations by Dr. John Q. Stewart, of Princeton, and 15 other persons under the direction of Lewis Lindsay, San Francisco amateur astronomer, tended to confirm the existence of the globular corona first described at the 1937 eclipse. The streamers of the sun's corona, which flashed out brilliantly and sharply during the 30 seconds of totality, seemed to be imbedded in a hazy luminosity surrounding the sun.

A general overcast of altocumulus clouds made the passage of the moon's shadow less spectacular than it would have been with clear skies. It was so dark that markings on a camera dial could not be read during totality. About 36 photographs of the corona and moon's shadow on the clouds, many of them in color, were taken, some by Dr. and Mrs. Ira M. Freeman, also of Princeton. The number of pictures includes those taken by James Stokley with a special camera which records the entire sky, designed by Frank Benford, of the General Electric Research Laboratory. Exposures were made from an airplane by James L. Artig, Jr., astronomy student at the University of Minnesota.

Mr. Artig, piloted by Harold Ebaugh at an altitude of 9,000 feet, reported that a band of condensed water vapor perhaps 15 miles wide formed during totality along the central part of the shadow track. This remained for several minutes after the sun reappeared.

TWENTY-SEVEN SECONDS of totality was about four seconds less than observers at Opheim, Mont., expected. On their last plates planned for totality, Albert V. Shatzel and Walter M. Lorenz, who had come partly by plane from Coleville, Cal., expect to find Baily's beads and a thin crescent of sunlight. Nine minutes before totality the sun had cleared a bank of altostratus clouds.

Their expedition was made in conjunction with the Frank P. Brackett Observatory of Pomona College, and with the assistance of the staff of Mount Wilson Observatory, who loaned instruments and provided film. Dr. Walter T. Whitney headed the group from Pomona College. The equipment included two corona cameras of 14 and 5 feet focus, respectively, and three motion picture cameras. The town jeweler is probably glad eclipses are not frequent affairs, for during the night of July 8-9, he was called upon to repair the mainspring of one of the heliostat clock drives.

FRANCIS is a town in Saskatchewan, close to the central line and directly southeast of Regina. That morning, H. S. McClung, Regina optometrist and amateur astronomer, and author of a fine set of advance stories in the Regina *Leader-Post*, drove with friends to Francis. He came out of clouds on the way down, and went back into them on the way home. But at totality the sun was in the clear.

As it was his first eclipse, Mr. McClung said: "I had no conception how grand it would be. I was so overcome I forgot everything else I had planned to observe and just watched the corona, which extended the full width of the moon on each side of the sun. I saw Baily's beads at both contacts, but there was no diamond ring."

A LIST of 51 amateur and professional astronomers sent us by Mrs. Margaret M. Back, secretary of the Detroit Astronomical Society, indicates the tremendous popularity of Wolseley, Sask., as an observing place. From Maine, Texas, Oregon, and points in between, these observers had arrived from eight days before to a few hours in advance of eclipse time. By sunrise Monday morning, some 150 automobiles had added considerably to the number of people in and around the town.

After a cloudy, red sunrise, and light clouds interfering with the first half hour of the event, visibility became perfect. One account mentions significantly that "except for a low bank of broken clouds in the general direction of Bredenbury," the weather conditions were extremely favorable. The temperature was about 38 de-

**A contact print of a hand-camera photograph by Carl P. Richards at Wolseley. Venus is prominent, and light from outside the shadow is seen.**

grees, "so chilly that it was difficult to hold binoculars steady."

Shadow bands were observed on white sheets laid down for the purpose, and two independent groups report that the bands moved directly from north to south. In one case they were seen for at least 30 seconds after totality, and the other group observed them both before and after. Baily's beads and a spectacular diamond ring appeared both before and after totality.

Activity at Wolseley centered around the expedition led by Dr. Roy K. Marshall, and sponsored jointly by the Associated Press and Philadelphia *Evening Bulletin,* the University of Pennsylvania, and The Franklin Institute. From their site in the yard of a school, Dr. Marshall broadcast over WPEN during the eclipse, with the assistance of Janet Anderson, a junior astronomer from Detroit. Accompanying Dr. Marshall were Dr. Orren Mohler, of the McMath-Hulbert Observatory, and Dr. Richard M. Sutton, of Haverford College.

Typical of the hospitality enjoyed by eclipse visitors were the efforts of the Wolseley townsfolk. On Sunday afternoon 34 persons attended a party at the home of the mayor of Wolseley.

FARTHER up the line, at a site one mile north and one mile east of Bredenbury, ground was broken one month before eclipse day. Here was established the most completely equipped of eclipse expeditions, under the leadership of Lt. Comdr. Donald H. Menzel, U.S.N.R., professor of astrophysics at Harvard University, and former editor of *The Telescope.* The observations at Bredenbury were part of a program sponsored by the Combined Wave Propagation Committee and the Canadian Radio Wave Propagation Committee, including flights by three airplanes under the

(*Continued on page 21*)

# Outward from the Central Line

OBSERVERS of the partial eclipse have sent in numerous and detailed reports. Some of these are presented in full below, some are condensed to avoid repetition, some will appear next month. Generally good weather conditions prevailed in all parts of the country, and advance newspaper accounts appear to have heightened public interest.

**Iceland.** Lt. B. C. Wiggin, stationed at Reykjavik, had hopes of flying north to the path of totality in its most favorable portion, where he would have seen an eclipse at high noon lasting 1¼ minutes. However, in Iceland, 90 per cent totality occurred as the sky cleared for the first time in a couple of weeks. Lt. Wiggin took a few pictures at 10-minute intervals.

"As there are no trees in Iceland," he writes, "I put some pinholes in a roll of paper, and everyone was interested in the crescent images they produced. I got some accurate time, and as nearly as I could tell without instruments, the eclipse went off to the minute as scheduled."

**Chapman Camp, B. C.** Along with a report on Venus mistaken for a Japanese balloon, E. K. White reports that the solar eclipse was seen in a cloudless sky, the disk of the sun being 70 per cent obscured at sunrise. Two small pairs of spots appeared quite light in contrast to the very black moon.

**Montreal, Que.** From Mr. and Mrs. A. V. Madge we have a detailed report of observations with a 2¾-inch equatorial refractor equipped with a solar cap for direct vision and with a screen for projection. They write:

"Immediately prior to first contact, approximately two seconds, a grayish mark was apparent at approximately 330 degrees from the vertex of the sun. At contact, a segment of grayish circle was clearly visible on the solar disk, lasting for almost one second after contact, then fading out. (This may have been caused by a defect in the objective or ocular, but we took note to look for a similar effect at last contact.)"

At mid-eclipse about 67 per cent of the sun's diameter was covered. Both observers agree that the moon appeared to be quite black at first, but later it seemed to have a faint, almost imperceptible, rusty tint with faint reddish highlights, no lunar configurations being visible. This slight coloration was noticeable during most of the remainder of the eclipse.

"Perceptible dimming of daylight took place by mid-eclipse. There was no noticeable radio interference. The segment of grayish circle was again viewed just prior to last contact and immediately thereafter, as seen through the eyepiece. Somewhat like an 'after-shadow'?"

Accurate timing of the contacts and of the covering and reappearance of two small sunspots was made by these observers, using an Elgin railroad watch and U. S. Bureau of Standards time signals.

**New York City.** Excellent photographs of the partially eclipsed sun were taken by R. E. Massot, of Flushing, Long Island, who projected the sun's image by means of his 6-inch Newtonian, using the wall for lack of a suitable screen. He is a member of the Optical Division of the Amateur Astronomers Association, and writes:

"During more than half of the eclipse I was engrossed in the contemplation of the moon's passage over the sun, and the two groups of sunspots visible, and was kept very busy trying to maintain the image on the wall because it was traveling at a fast clip, as you will judge by the size of the image which measured approximately six feet across.

"Finally, during the second half of the eclipse, the image was so sharp and clear that I decided to try taking some pictures with a Kodak 122. As these pictures were taken without any preparation whatsoever, they might encourage other amateurs with small telescopes to make similar observations of the sun at any time. This, my first experience with celestial photography, has greatly stimulated me to expedite the completion of a camera attachment and a clock drive for my telescope."

(*Continued on page 21*)

**On the wall of his bedroom, R. E. Massot photographed partial eclipse.**

# TRIP TO THE MOON

By MARIAN LOCKWOOD

*Here is a travelogue to take on your next trip to our satellite, or to review after you have taken the moon journey in the Hayden and Buhl Planetariums this month.*

*. . . the moon's an arrant thief,*
*And her pale fire she snatches from the sun.*

—SHAKESPEARE

THE fantastic details of a trip to the moon are today no longer merely part of childhood's dream, but constitute the background of a stimulating challenge to that serious scientific dreaming which precedes progress. Some serious experts in the field of rocket engineering believe that successful trips across the 240,000 miles which separate us from the moon are not entirely beyond the possibilities of the future. Multitudinous are the problems still to be solved in the field of interplanetary rocket travel, and pre-eminent among these is the problem of fuel. One recalls with interest the recent great advances in rocket-bomb and aeroplane speeds, rocket bombs surpassing the speed of sound. To an astronomer, however, the problems of carrying sufficient oxygen to the moon, of surviving while there, and of getting started back home again once the lunar journey is achieved, would seem to be almost overwhelming.

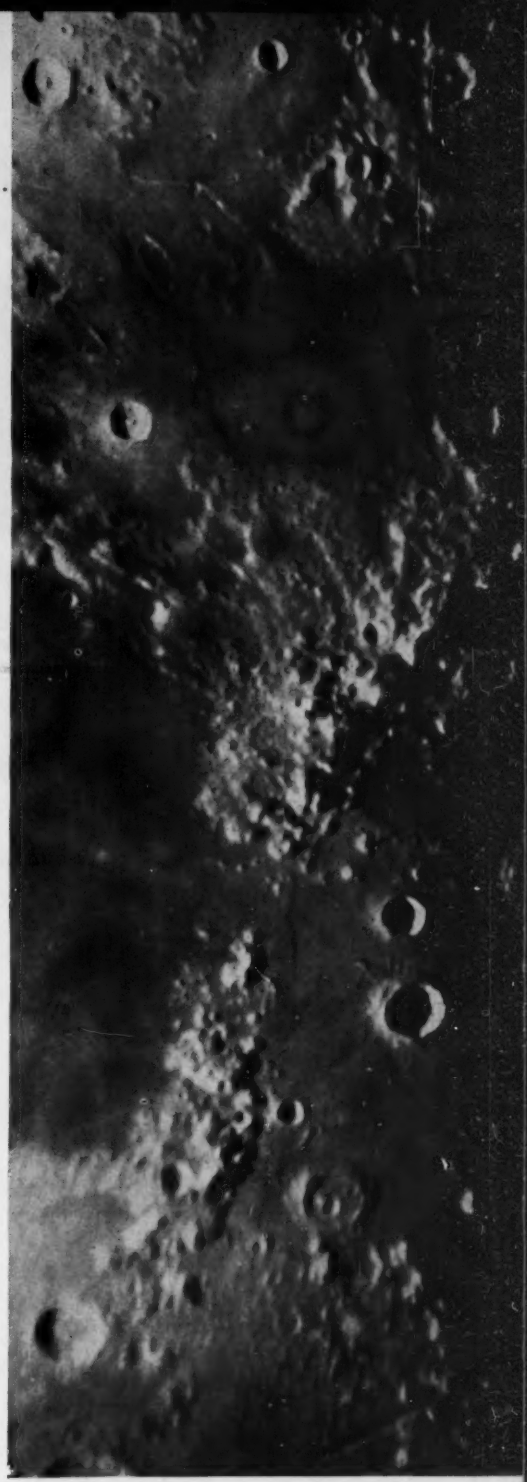
But let us suppose that all difficulties of rocket travel have been overcome and that we are about to take off from the planetarium rocket depot. We are ready with oxygen tanks and all kinds of clothing packed in our luggage. We shall encounter great extremes of temperature on the moon, and shall therefore need to take with us both asbestos outer garments and electrically heated suits to protect us from the tremendous and alternating heat and cold. We rise from the surface of the earth with a speed exceeding 7½ miles a second, a speed which is necessary to enable us to escape the gravitational clutches of the earth. If we attain the fairly "moderate" speed of 10 miles a second, we shall land on the moon's surface in less than seven hours.

Our pilot sets the rocket ship down on the depressed floor of a medium-sized crater on the moon. Recovering quickly from the slight jar occurring as the ship lands, we look out of the windows and see in all directions the distant lunar horizon with its mountain ranges and towering peaks. It is believed that the highest lunar mountains have an altitude of about 25,000 feet, comparing very favorably (in view of the moon's much smaller size) with the highest mountains on the earth. Mt. Everest, the highest measured mountain in the world, attains a height of about 29,000 feet.

We notice immediately the startlingly different lunar sky. We have arrived on the moon at noon, when the sun is at its greatest height for the day. It shines, a brilliant disk, against a nearly black sky dotted with stars. The lack of an appreciable atmosphere upon the moon is responsible for many of the most spectacular differences we shall notice. It is this absence of air which enables us to see the stars and the sun at the same time. In our earth sky, because of our dense atmosphere, the light of the sun is scattered and reflected by the particles of dust and molecules of air, creating above us a bright envelope through which we cannot see the relatively faint stars. This strange condition of the sky, with stars and sun visible at the same time, we should find duplicated on the surface of the planet Mercury, for Mercury, like the moon, boasts no atmosphere.

Next we notice something that looks very much like a large moon in the lunar sky. This "moon" is the earth, of course, illuminated by the light of the sun. It appears about four times the diameter of the moon in the terrestrial sky. We realize that the earth as seen from the moon passes through a cycle of phases duplicating those of the moon itself as seen from the earth. When we first observe the earth, it is at the crescent phase, with the cusps of the crescent pointing away from the sun, as is always the case for terrestrial observations of the crescent moon.

We have by this time become very much aware of the tremendous heat at full lunar midday, with the temperature at about 214 degrees Fahrenheit. We must be prepared for a long period of intense heat because the lunar day is two weeks long—the night will be of the same length. The moon's period of rotation equals its period of revolution around the earth, approximately four weeks. Also,



**A portion of the moon's surface as photographed with a 12-inch reflecting telescope, by projection through a 1-inch eyepiece; exposure, 1/3 second. In the central portion are the lofty lunar Apennines, with peaks ranging from 12,000 to 20,000 feet high. The two prominent craters below are Aristillus (larger) and Autolycus, the former 35 miles across. At bottom right are the lunar Alps, and the Alpine Valley, a deep cut 75 miles long and from four to six miles wide. Photo by Latimer J. Wilson.**

as a result, the same side of the moon is always turned toward the earth.

Since we have arrived on the moon at noon we may expect one week of sunlight before the sun sets behind the western horizon. Then night will follow, lasting for two weeks before the reappearance of the sun over the eastern horizon. The moon rotates from west to east just as the earth does, even though much more slowly.

As the sun sinks down the western sky, the stars and planets appear to move along with it. The only object which remains strangely fixed in the lunar heavens is the great moon-like body, the earth. We are interested in watching the earth's change of phase. By the time the sun has reached the western horizon, the earth, which is slightly to the east of our lunar meridian, has passed the first-quarter phase. We can see vague outlines of continents and oceans on the earth's surface, but heavy clouds above that surface make it hard to distinguish details.

With the coming of sunset we must not expect a period of twilight. We shall pass abruptly from brilliant sunshine into the deepest blackness of night. The periods of twilight and dawn upon the earth are the result of the reflection and refraction of the light of the hidden sun while that body is still below the horizon. On the moon we see the sun disappear over the horizon, and night follows immediately. Long before sunset, the temperature has dropped below zero, and we are now wearing our heavy electrically heated clothing.

The weather in the first hour of the long lunar night does not change. One may say that there is no weather on the moon, except the extreme but always reliable changes in temperature; one week after sunset we experience —243 degrees Fahrenheit! Where there is no air there can be no rain, no wind, no clouds in the sky, no storms of any kind. By the time we are ready to return home we shall perhaps be glad to see again the many varied and beautiful manifestations of earth weather. Not only is all weather on the moon lacking, but there is no sound here, nor can one detect any odors, for without air these two senses cannot function.

**The partial phase of a lunar eclipse.**

One of the oddest things we notice is the difference in our weight. The moon is so much less massive than the earth that its gravitational pull for objects at the surface is only about one sixth that of the earth. Here, therefore, you weigh one sixth as much as you did at home. This difference in weight is pleasantly noticeable in the greater ease with which we walk about and climb mountains; with our earth-trained muscles we can leap and jump many times as far as on the earth.

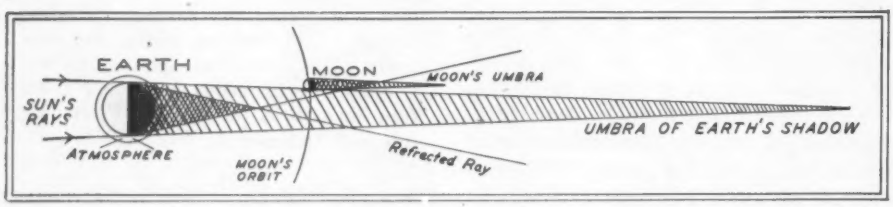
After an intensely cold night, lasting two long and silent but beautifully clear weeks, the sun rises on a lunar day particularly auspicious for our journey to the moon. Before noon, lunar time, we shall be the first observers in history to see an eclipse of the sun by the intervening disk of the planet Earth. As seen from the earth, an eclipse of the sun occurs when the solid body of the moon comes between us and the sun. Here conditions are, naturally, just reversed, and the sun is obscured when the earth, at its "new" phase, comes between moon and sun. While the moon's rotation carries the sun westward to a position behind the earth, the light on the lunar surface fades gradually to a ghostly, dark-red radiance. Everywhere around us, out to the farthest horizon, the surface of the moon appears blood red. If you have ever seen an eclipse of the moon from the earth, you will recall the reddish color of the moon during the total phase. Of course, this eclipse, which we see from our position on the moon as a solar eclipse, appears at the same time to our friends on the earth as an eclipse of the moon. The red color is caused by the bending in the earth's atmosphere of the longer wave lengths of sunlight; they pass partially around the earth into its shadow, finally reaching the eclipsed moon.

After the period of totality has passed, the sun appears again from behind the earth and moves slowly across the lunar sky toward the west. The day seems particularly bright after the eerie red darkness.

During this second and last after noon on the moon, about seven days long, we study especially the craters, the mountain ranges, and individual mountain peaks. One of the outstanding controversies among astronomers has to do with the origin of the lunar craters. One school of astronomical thought believes them to have been caused by volcanic activity on the moon. Other astronomers believe in the theory of meteoric impact, describing the craters as the result of the collision of the moon with large and small meteoritic bodies. Possibly a combination of both ideas is nearer the truth. The craters vary considerably in size. The smallest ones are probably much too small to be seen from the earth even through large telescopes. The biggest ones are about 150 miles in diameter. In the centers of many craters, tall mountain peaks rise loftily above the crater floor.

Outstanding among the moon's surface features are the great maria, or plains. The name was originally given to these regions because the early astronomers thought them to be actually oceans of water. Today we know that there is no appreciable amount of water on the moon.

As we travel homeward in our swiftly moving rocket ship, we reflect upon the entire lack of life and activity on the earth's satellite. It is indeed a dead world. The question arises in our minds as to the existence of life in other parts of the universe. Is it possible that ours is the only heavenly body inhabited by living creatures? Or are there other solar systems, with families of planets, and moons around those planets, lighting their skies with ghostly light?




**The shadow of the earth extends beyond the moon several times farther than the moon's own shadow. Some light is refracted by the atmosphere into the umbra of the earth's shadow.**

# Notes on the Nature of Light

By Duncan Macdonald, *Boston University*

## Part I

PYTHAGORAS and his followers (500 B. C.) thought that vision resulted when particles emitted by an object entered the eye, while Plato (400 B. C.) and his students held that vision occurred when a stream of corpuscles emanating from the eye struck the object being seen. Today we realize that light comes from the object by reflection from it, transmission through it, radiation by it, or a combination of these, but as to the nature of light — that is not such a simple story.

In a previous article (*Sky and Telescope,* March, 1944), we saw that light has a finite velocity, and traced a brief history of the determination of that velocity. You may have wondered what could be the significance of these figures, and why so much attention has been given to the measurement of the velocity of light. It is probably true that more time and energy have been spent on the determination of the precise speed of light than on any other constant of nature. The emphasis is partly because this speed is fundamental in so many fields of physics. Visible light, infrared rays, radio waves, X-rays, electrical impulses, and heat radiation travel with this velocity. The ratio of electrostatic and electromagnetic units is the velocity of light. According to relativity theory the most fundamental velocity in the universe, the upper limit of all physical velocities, is the speed of light in a vacuum. In addition to the sheer satisfaction that scientists have had in conquering such a difficult problem as that of the measurement of the speed of light[1], they have opened vast new areas of thought by their results.

**When light passes a straight edge, diffraction produces a pattern such as this, where some light is bent into the shadow and the intensity just outside the geometrical shadow is considerably brighter than if the edge were not there at all; compare the first diffraction maximum with the area of uniform illumination at the left. From "Optics," by Francis W. Sears.**

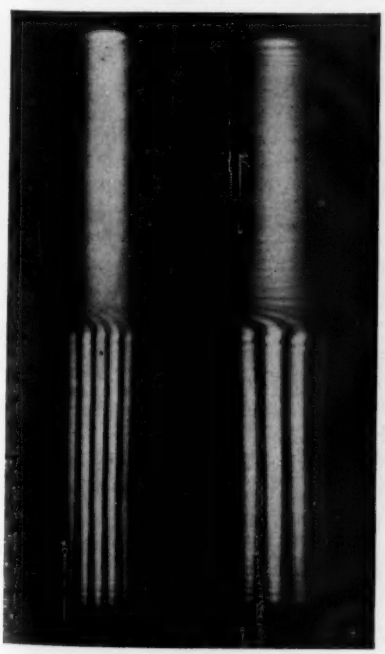
In the latter part of the 17th century, two theories of the nature of light were predominant. Sir Isaac Newton (1642-1727) favored the idea that light is a stream of corpuscles, and suggested that these corpuscles were emitted in fits and starts by the light source. Christian Huygens (1629-1695) held to the view that light is a wave motion.

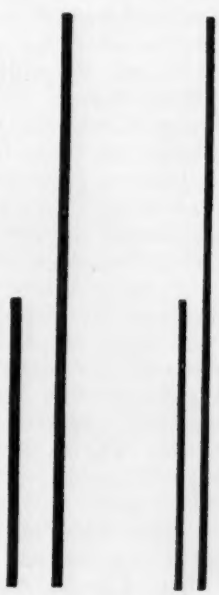
[1]N. E. Dorsey, formerly of the U. S. Bureau of Standards, published in 1944 a reanalysis of modern measurements, and gave the velocity of light in a vacuum as 299,773 kilometers per second, error 10 kilometers per second.

The phenomenon of *refraction,* the bending of a light ray as it passes obliquely from one medium to another, was correctly attributed by both of these scientists to the difference in the velocities of light in the two media. In Newton's particle theory, light corpuscles would travel faster in a more dense medium because of gravitational influence, whereas in Huygens' wave theory, light waves would slow down in the more dense medium, due to friction. Either theory could be interpreted, in the knowledge of those times, to produce the observed effect, but because of Newton's great prestige and the limited experimental data, his explanation held precedence for over a century.

The physicists of the 18th and 19th centuries reasoned that wave disturbances should bend around corners, as in the case of sound waves, or, for an easily observed example, ocean waves around a pier. On the other hand, a stream of machine-gun bullets (corpuscles) passing a corner does not bend. This bending of waves around the edge of an obstacle is known as *diffraction,* and for waves traveling with low velocities, such as sound and water vibrations, it had been well observed.

At the beginning of the 19th century, Thomas Young (1773-1829) announced the results of experiments which showed that light was diffracted, and also that the mutual interaction of light beams produced interference patterns. Young explained the observed color of thin films (the color seen in an oil film on a roadway) as the result of the *interference* of light waves. He also took the bold step of suggesting that light was a transverse wave motion. However, it was not until 1816 that Augustin Jean Fresnel (1788-1827) presented the





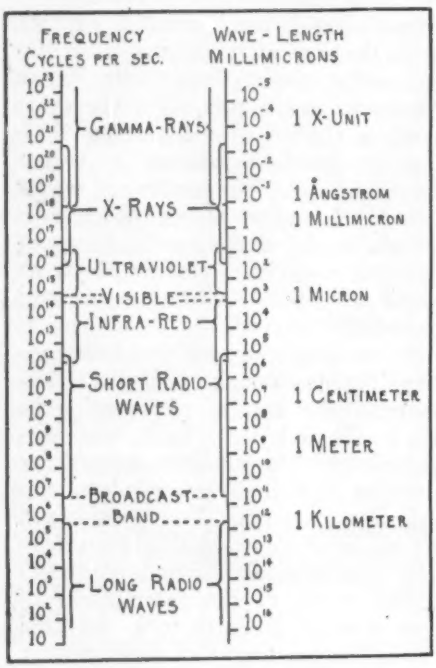
**In Young's experiment, diffraction causes parallel light passing through a single slit to produce an image wider than the slit itself, and wider for a narrower slit. Interference of the light from two slits produces bands or fringes. From "Optics," by Francis W. Sears.**

true theory of the diffraction of a light wave by a slit or a wire. Because the velocity of light is so great that it bends only a small amount in passing an edge, the minute effect had simply escaped detection until Young performed his experiments.

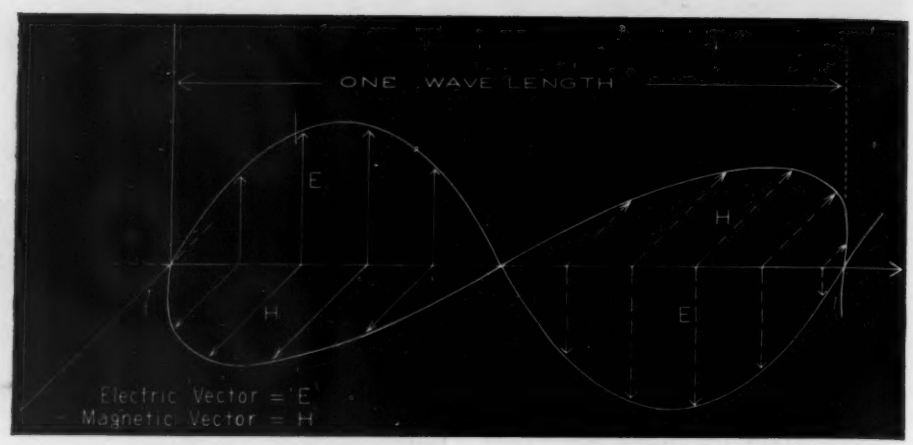
It was not until several decades later that Jean Bernard Léon Foucault (1819-1868), whose work on the velocity of light was described in the earlier article, showed that light travels faster in a rarefied medium than in a dense one. By his rotating mirror method, he found that the speed of light in water is about three quarters of its speed in air. With the weight of this evidence, Newton's corpuscular theory was finally completely overthrown, and science adopted the theory that light is a wave motion.

It was only natural that these two theories, the wave and the corpuscular, should have arisen, for light is a form of energy, and the only known way in which energy can leave one point and arrive at another is by a transfer of material (corpuscular theory) or by a vibration mechanism (wave theory).

One of the main problems that accompanies the wave theory is the fact that a wave must travel in something. In what medium can a light wave travel? Light shines across empty space and it penetrates the densest steel. Whatever this medium may be, it must be present in empty space, in steel, in everything. The medium must, of course, be transparent. We are not conscious of its presence nor do the celestial bodies show signs of mechanical friction as they pass




**The electromagnetic spectrum. From "Optics," by Francis W. Sears.**




**The components of a wave of electromagnetic radiation.**

through it, hence its density must be exceedingly low. (In one theory, however, that of Osborne Reynolds, this medium is of very high density, and mass as we observe it is a kind of hole or negative density in space, making our concept of density a mirror-like reflection of the true state of affairs. This is quite characteristic of many pre-relativistic theories that have filled space with a material structure.)

This hypothetical, all-pervading medium must be of very high elasticity to force a wave through itself at such a speed. What medium could fill all these requirements? Along with the 19th-century physicists, let us invent the *ether* and say it has just these properties.

This original ether was, therefore, an elastic solid medium of great rarity consisting of particles that vibrated in such a way as to transmit light waves. Later modifications caused the abandonment of this highly artificial particle concept in favor of a continuous medium called the luminiferous ether, which possessed the elasticity-density characteristics necessary to allow for wave transmission at the velocity of light.

The famous English physicist, James Clerk Maxwell (1831-1879), brought the wave theory of light to its point of greatest development. He showed, in a paper presented before the Royal Society in 1864, that all the known facts of electrodynamics could be attributed to the action of a medium. It turned out that this medium had properties identical with those of the luminiferous ether, and the identity of light as an electromagnetic radiation was then established. The nature of the radiation is that of an electric field oscillating in phase with but perpendicular to a magnetic field, the two being in constant association.

The only difference between (visible) light and the other electromagnetic radiations is the frequency of the oscillations. The frequency is established by the energy change occurring within the radiating atom or by the rate of oscillation of an electric circuit. The frequency of an electromagnetic oscillation is forever constant. It may *appear to change* if observer and source are in relative motion (the Doppler effect). The relation, velocity equals frequency times wave length, determines what occurs. For example, refraction occurs because the velocity of the radiation changes as it passes from one medium into another of differing density. In water, light travels at ¾ its speed in air. But the frequency is constant and cannot change; hence the wave length of light in water is ¾ its wave length in air.

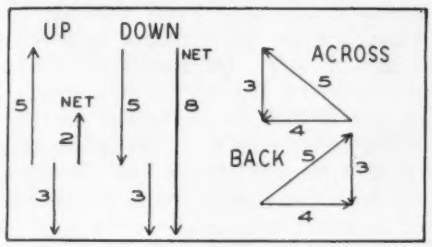
Radio stations send out low-frequency (radio) electromagnetic radiations, those in the ordinary broadcast band vibrating from 500 to 1,500 thousand times a second. X-rays are of high frequency, vibrating about a billion billion ($10^{18}$) times per second. Visible light is of the intermediate frequencies of the ether gamut, as shown in the accompanying illustration. As the product of frequency and wave length equals the velocity, which is very nearly $3 \times 10^{10}$ centimeters per second in a vacuum, one may easily compute wave length from frequency, and vice versa. Thus, 1,000-kilocycle ($10^6$) radio waves are about 30,000 centimeters or 3/10 of a kilometer long, whereas some X-rays are only one angstrom unit in length, that is, about 1/100,000,000 of a centimeter. Fifty thousand waves of green light can be crowded into an inch.

Thus had Maxwell replaced the elastic ether with one of electrical characteristics, fields of electric and magnetic energies, when, in 1881, Albert Michelson (1852-1931) and Edward Morley (1838-1923) set out to see how the earth moved through

the ether, that is, to detect the fundamental "at rest" system of the universe. If the ether exists throughout space, the earth traveling in its orbit should be moving through this ether and should create an ether wind.

A swimmer covering a certain distance up and down stream will take longer than an equally fast swimmer going that same distance across the stream and back, as shown in the following example:

Assume two equally fast swimmers can travel five miles per hour in still water. They engage in a contest in a river which flows at three miles per hour and is four miles wide. Swimmer A goes four miles upstream and back to the starting point; on the trip upstream he is bucking a three-mile current, giving him a net velocity of two miles an hour with respect to the shore; on his return he swims with the current, so his speed is eight miles an hour. Swimmer B, on the other hand, loses some speed relative to the shore because




**The swimmers' problem.**

he must head upstream to compensate for the current. As shown in the diagram, the combination of current and his five-mile speed through the water gives him a resultant velocity of four miles per hour at right angles to the shore. Their respective times are:

*Swimmer A*

| *Distance* | *m.p.h.* | *Time* |
|---|---|---|
| 4 mi. up | 2 | 2 hrs. |
| 4 mi. down | 8 | ½ hr. |
| 8 mi. total | | 2½ hrs. |

*Swimmer B*

| *Distance* | *m.p.h.* | *Time* |
|---|---|---|
| 4 mi. over | 4 | 1 hr. |
| 4 mi. back | 4 | 1 hr. |
| 8 mi. total | | 2 hrs. |

This difference in time in swimming up and down a stream, as compared with the time across and back, was the effect Michelson and Morley hoped to detect, regarding a light wave as a swimmer and the ether wind as the stream. The apparatus used by these scientists consisted of a large interferometer, with two arms of the same length at right angles to each other. The light was reflected back and forth along each arm. In such an arrangement, combined with optical means employing the principle of interference, it is possible to detect very small differences in the velocity of light traversing each arm.

During the course of repeated trials, first one arm was turned in the direc-

(*Continued on page* 15)

# NEWS NOTES

By Dorrit Hoffleit

## THE YOUTH OF SPIRAL GALAXIES

In his lecture before The Franklin Institute as recipient of the Franklin medal, Dr. Harlow Shapley, of Harvard Observatory, presented new ideas on the relative ages of spiral and ellipsoidal galaxies. Many years ago, Sir James Jeans had assumed that the spheroidal galaxies are the younger—spiral galaxies evolving from the spheroidal as they became flattened through rotation and developed spiral arms. Dr. Shapley, on the other hand, presents reasons for believing that the spiral galaxies are the younger.

Differential rotation should eventually eliminate irregularities such as star clouds, clusters, and dust clouds. With increasing age, smoother structure should ensue. Many supergiant stars are observed in spiral and not in spheroidal galaxies. The supergiant stage of evolution is comparatively short, and such stars are believed to be relatively young. Unless supergiants are still being born, their presence in spiral galaxies may be assumed as an indication of the youth of such systems.

## ANOTHER THEORY OF PLANETARY EVOLUTION

G. Gamow and J. A. Hynek review in the *Astrophysical Journal* a new theory by C. E. von Weizsäcker, of Germany, who, they believe, "has directed a fresh stream of thought into the long-stagnant pool of theories of planetary origin." According to the new theory, an already well-developed primitive sun was surrounded by a nebular shell, in rotation, whose composition was much like that of the present sun, but not like that of the present planets; that is, it had a high hydrogen content.

This shell had a mass about 10 per cent that of the sun. Such a rotating shell would in time assume the form of an equatorial disk. The greater part of its mass, being composed mainly of hydrogen and helium, would eventually have dissipated into space, "carrying away with it the troublesome angular momentum" that constituted the main obstacle to success of so many older theories. Explanation of the formation of the planets from the residue of heavier elements involves vortices in the streams of material where collisions between particles occurred, large ones growing at the expense of the smaller; the difference in the physical characteristics of the giant and terrestrial planets is explained by this means. The physical theory of the manner in which this occurs appears capable also of accounting for the heretofore mysterious Bode's law of relative planetary distances.

## PROFESSOR VAN BIESBROECK RETIRES

On July 1st, Professor Georg Van Biesbroeck will be made professor emeritus of astronomy at the University of Chicago. All students at the Yerkes Observatory in the past many years remember him as their guide and mentor in operating the large 40-inch refractor. Professor Van Biesbroeck belonged to the Royal Observatory of Belgium from 1908 to 1917, and in 1915 came to the United States as a visiting lecturer. In 1922 he became a citizen of this country. He is well known for his work on double stars, comets, and asteroids.

Last year, at McDonald Observatory, Professor Van Biesbroeck discovered the intrinsically faintest star known; he has also found two comets which bear his name. Because of his early training in engineering, the Belgian astronomer has always been interested in the design and construction of astronomical instruments. At present he is engaged in the design of a new spectrograph to study the infrared radiations of stars and nebulae; this instrument will be attached to the 82-inch reflector at McDonald Observatory.

The Yerkes astronomer expects to continue his numerous researches and to travel, as he has for the past 12 years, to McDonald to carry on observing programs.

## A NOVA-LIKE VARIABLE

Harvard Announcement Card 711 reports that Dr. W. J. Miller, S. J., in the course of a survey of objective-prism plates at the Leander McCormick Observatory, has found a 12th-magnitude star in Lyra with a spectrum which appears to be similar to that of a nova. The 1900 position is $19^h\ 14^m\ 14^s.8, +42°\ 37'\ 41''$. The star is a variable, apparently with recurrent-nova characteristics.

Examination of Harvard plates from the 1890's shows this star to have reached a maximum of the 11th or 12th magnitude several times in the past 50 years. Most recently, it was between 10.5 and 11.0 from May 29 to June 4, 1944.

# Amateur Astronomers

## JESSE A. FITZPATRICK

ENGINEERS often turn to amateur astronomy for a hobby to which their technical training and interests may be applied in strictly leisure-time pursuits. Telescope making, observing, computing, and study of the mathematical principles of astronomy are broad fields in which the business-man scientist may find many hours of fascinating enjoyment.

With Jesse A. Fitzpatrick the stars were a hobby since childhood, and when health forced his retirement from active business before his 50th birthday, he turned to astronomy as a worthy outlet for his very active and engineer-trained mind. Readers of *Sky and Telescope* and of The SKY since January, 1941, have benefited by having Mr. Fitzpatrick as editor and chief contributor to our Observer's Page. He was mainly interested in phenomena of the solar system, probably because these gave opportunity for detailed calculations and predictions. He had thorough command of the problem of predicting occultations, including at least two methods he devised himself.

Among amateurs corresponding with Mr. Fitzpatrick concerning such methods was G. B. Blair, of Reno, Nev., who wrote concerning the method outlined in *Sky and Telescope,* June, 1943: "Your calculation, however, is quite a bit shorter than mine and I plan to use it in the future in the case of most occultations or near occultations." Mr. Blair also proposed some further refinements of this semi-graphical method.

The New Rochelle amateur was born in Brooklyn, a son of James C. Fitzpatrick, an editor of the old New York *Herald.* He studied engineering at Cornell University, worked for Post and McCord in New York City, and then established his own engineering firm, specializing in the design of power-station and utilities equipment. After some difficult times, Mr. Fitzpatrick's business venture was very successful, but about 1930 his physician said his health would not permit his continuing to work for even a few months more.

With his wife and daughter, who survive him, the now full-time amateur astronomer visited many parts of the world. Occasionally, astronomical incidents he recalled from his world-wide travel experiences furnished interesting items on the Observer's Page, as reference to past issues will show. He maintained a winter home on the island of Barbados, in the British West Indies, and enjoyed comparing the heavens as seen from within 15 degrees of the equator with those observed from the roof of an apartment house in the suburbs of New York City.

**Jesse A. Fitzpatrick**

Everyone in that apartment house, as well as many friends in New Rochelle, knew of and shared his observing activities, for he frequently invited friends to enjoy special astronomical events. His two telescopes, one a 4-inch Selsi and the other a 3-inch refractor of the same make, were carried to the roof each time he observed and were mounted in special hollow pipes installed in the parapet of the roof. This gave a very stable mounting and eliminated the necessity of carrying up the tripod. No amateur kept his instruments in better shape—they are as spotless and perfect as when purchased many years ago.

His desire to share his knowledge and his facility for noticing minute and interesting details made Jesse Fitzpatrick an unusually fine amateur astronomer. At the same time he was very modest and always willing to co-operate in carrying out our editorial requests and suggestions. His enjoyment of astronomy is mentioned by James C. Hickey, who writes "The Stars of the Week" in the New York *Sun.* In closing his report of Mr. Fitzpatrick's death, Mr. Hickey says:

"He frequently telephoned this writer when he had espied something interesting in the sky. We regret that his voice, with the salutation, 'This is Fitzpatrick,' will be heard no more."

C.A.F.

## EASTBAY ACTIVITIES

Suggestions about future meetings and programs have been requested from members of the Eastbay Astronomical Association, by their new president, Will J. Hewitt, of Berkeley, Cal. The various types of programs may provide hints for other groups in getting their fall and winter activities under way. A lecture, a discussion, an evening of observation with telescopes, or a program involving problems in building a home variety of telescope, are all possibilities. A number of societies through the country, following the example of many radio programs, have held successful quiz programs.

An invitation to a sun party at the Chabot Observatory on June 9th was included in the June *Bulletin* of the Eastbay Astronomical Association. A full program of afternoon and evening activities was planned, including use of the Evans monochromator on the 8-inch telescope, with opportunity to view sunspots and prominences. A visual spectroscope was to be attached to the 20-inch telescope, which was also scheduled to provide a daytime view of one of the planets.

## FISH AND THE AURORA

Night fishing in a Michigan lake turned from a fizzle into a sportsman's dream a couple of years ago during a brilliant auroral display. The account was carried in *Hunting and Fishing,* March, 1945, according to the Texas Observers' *Bulletin* for May. The fishermen could not get a nibble from sunset till after midnight, but when the aurora appeared:

"A magazine could have been read, and the whole lake seemed ablaze from the reflection. At this moment all around us the lake came to life; it actually boiled with fish breaking water and jumping all over, near the boat and as far as we could see." In 15 minutes one man got his limit, and two others each caught three fine bass. Quietness returned when the aurora weakened, and for another two hours the fishing was as unsuccessful as earlier.

## THIS MONTH'S LECTURES

*Indianapolis:* "Dog Days" is the subject of the talk by W. G. Gingery at the meeting of the Indiana Astronomical Society on August 5th, Sunday, at 2:15 in Odeon Hall.

# ASTRONOMICAL ANECDOTES

## THINGS THAT GO "WOMP" IN THE NIGHT

THE story on page 10 of the June, 1945, issue of this magazine reminds me that I have had stored away for about a year some material about the "Patten Meteor." Except for this material, which I was permitted to copy from a prospectus by John Patten, of Baltimore, I have never heard of the curious event that I shall describe in what follows.

At 5:30 p.m., on November 5 or 10, 1907, according to an eyewitness, "the greatest known meteor fell with a crashing noise and dazzling flash of light, four miles west of my residence in Coyoto, Garfield County, Utah. . . . My two sons Francis and Merlin [Jolley] and other citizens of Coyoto observed a great streak of dazzling light suddenly come from the north, descending at an angle of about 30°, stopping four miles west, where the meteor struck the east side of a mountain of solid rock. A few seconds afterwards, myself, family and neighbors were startled by the loudest crashing noise we have ever heard, which caused us all to rush from our houses and see a great cloud of dust that had been forced into the air from where the meteor had struck. . . .

"I had the pleasure of finding where the great meteor had struck, which was the most wonderful sight I ever saw. I first discovered some freshly broken boulders and smaller rock that had rolled down the hillside of Pole Canyon, four miles west of Coyoto. By following this evidence I discovered a freshly-cut channel about twenty feet wide and a hundred feet long, partly filled with finely pulverized rock and freshly broken large boulders. . . . It looked like over a hundred thousand tons of rock on the side of the mountain had been disturbed. . . .

"Later a mining man of Marysvale, Utah, Mr. Reuben DeWitt, his family and friends, commenced work at the place where the meteor fell. . . . Finding the great chasm . . . had been refilled with loose boulders, surrounded by finely pulverized rock, and the rock side-hill to the south broken and shattered. . . . [led him to write under date of May 18, 19131 'Now you must come and see this Wonder of the World. Nothing like it has ever been found up to date. There is no sign of fusion, only smoky rocks. . . . I am just down from the meteor camp and I tell you it is a wonderful sight. The boys have removed about three hundred tons of finely crushed stone that was drawn in after the meteor by suction. . . . As the broken rock is removed the sight becomes more wonderful. There is not such another sight known on the face of the earth. It would pay any man interested in such things to come from the other end of the earth to see such a sight.'"

Reuben DeWitt and others secured title, under the mining laws, to the land where the meteor fell, within the boundaries of a 20-acre mining claim. They sank a shaft over 40 feet deep, south of the great gash, then ran a drift or tunnel about 15 feet toward the spot where the body was supposed to lie. The drift was then raised vertically, but when it broke into the path of the body, finely pulverized rock, like quicksand, filled the shaft. They then dug a tunnel, commencing down the hillside some 50 or 60 feet, and again pulverized rock was encountered. About 1,500 tons of this fine stuff and small rocks were moved before large boulders of native rock were encountered. Work was suspended occasionally, but as late as 1920 there was some more accomplished.

The prospectus was intended to interest investors in a project to complete the excavation. The project appears now to be abandoned; John Patten ("The Patten Meteor Company") used as his address that of the Maryland Academy of Sciences in Baltimore, as late as March, 1921, but I have no information as to further activities by anyone.

Now the questions arise: Did a great fireball flash through the sky on that evening, almost 38 years ago, and did it crash into the east side of Mt. Dutton, in longitude 112° 3′ W., latitude 38° 7′ N., at an elevation of 8,480 feet above sea level? If not, why would these people slave away at what impelled them to say, "There is not such another sight known on the face of the earth"? What produced all this pulverized rock? What was the great cloud of dust that rose at the time the tremendous crashing noise was heard? Why has this occurrence gone unmarked in astronomical literature? Why did not someone get a sample of the pulverized rock, to examine it for nickel-iron?

Here we have either a most elaborate fraud, complete with photographs, drawings, and a list of 27 names of eyewitnesses, or we have evidence of considerable laxity on the part of astronomers and geologists. Is it too late for some enthusiast to prowl around out there on the side hill of Pole Canyon, to see what he can see? Panguitch is the county seat, about 30 miles southwest of Mt. Dutton; Antimony is a town about 15 miles northeast.

My ton of the meteorite, when it is found, may be shipped to me, express prepaid, in care of the editor of *Sky and Telescope*.

R.K.M.

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### WESTERN RESERVE ASTRONOMY

On May 23rd, it was announced that the Western Reserve University astronomical observatory, originally established in Hudson, Ohio, as the first observatory west of the Alleghenies, will become increasingly active in the immediate future. It has a 10½-inch refracting telescope, which will be renovated and put to use for teaching and public nights.

Professor Henry F. Donner, head of the Western Reserve department of geology and former astronomer with the University of Michigan Observatory in Bloemfontein, South Africa, will be in charge of instruction in expanded courses in astronomy. A series of public nights will also be conducted in the fall. On the research side, Professor Donner plans to continue the work on double stars which he carried on at Bloemfontein from 1927 to 1933.

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### FLYING SCIENTISTS RELOCATE MAGNETIC POLE

British-Canadian aviators, in a two weeks' tour of the polar regions, have added considerably to our knowledge of the problems of navigation over the top of the world, visited the geographical north pole, and relocated the magnetic pole from 200 to 300 miles north-northwest of the location usually given on maps.

The magnetic pole is now probably at Sverdrup Island, and no longer on Boothia Peninsula, but this is not too much of a surprise, as the location of the magnetic pole is constantly shifting.

Their plane was a converted Lancaster bomber, the *Aries*, and leader of the expedition was Wing Commander D. C. McKinley, who said, on his return to England on May 26th:

"We were not just looking for air routes. Our main job was to study air-crew co-operation and efficiency and navigational problems, especially in the vicinity of the magnetic pole, and in a small way, the topography of that area."

# MOON M

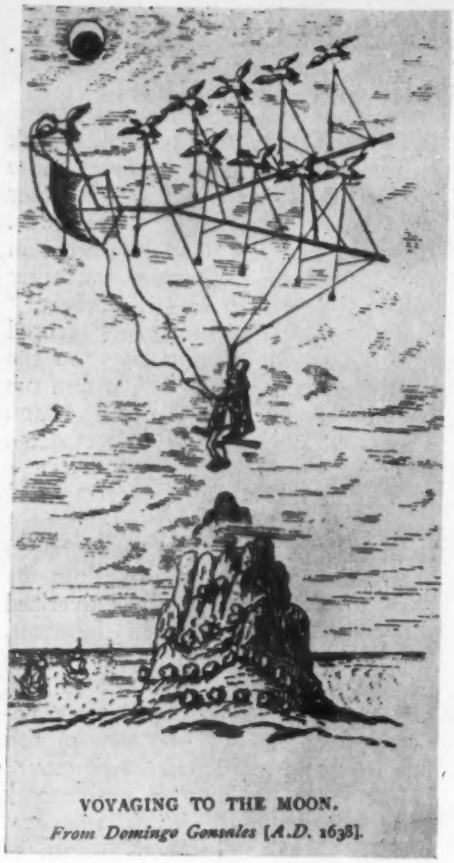
By MILDRED WI

NO CELESTIAL BODY has been the cause of more mad conjecturing than the moon. Visible mostly during the hours of rest and solitude, it has inspired much of man's musing. Fools, poets, satirists, scientists, the wise and the mad, have all gazed on it and spoken their serious or most absurd opinions. That the moon, herself, may have grown weary of being so treated was appreciated by one of the earliest of these observers, Lucian, for he makes her say:

"I am tired to death of being slandered by these philosophers; they have no better occupation than impertinent curiosity about me—What am I? How big am I? Why am I halved? I am inhabited; I am just a mirror hung over the sea; I am—whatever their latest fancy suggests. It is the last straw when they say my light is stolen, sham, imported from the sun . . . they might have been contented with making *him* out a stone or a red-hot lump."

And so they guessed at her size, her substance, and her shape. Her mountains and valleys have resembled a man, a lion, or a fox, and, as for her eclipses, they have caused particular consternation. The old Romans, thinking the world had shut one of its eyes, made much racket and brandished torches to urge it open again. And there is the story of how, while an ass was drinking, the moon slipped behind a cloud, and the people killed the ass, thinking it had swallowed the moon, too.

Our consideration, however, will be limited to a brief glance at the "moon journey." Lucian's *The True History* etc. (c. 170 A.D.) is the ancestor of countless fantasies of such travel, a pure parody of the exaggerated tales so frequently brought home by ancient travelers. Moved by "a certain intellectual restlessness"—the reason for so many expeditions, imaginary or actual—Lucian pretended that he assembled a crew and embarked for the unknown. Overtaken by the inevitable storm, and his ship elevated some 350 miles above the sea by a waterspout, he and his crew continued to rise for a whole week until they landed on the moon. Here they were cordially welcomed, possibly because the moon was about to engage in battle with the armies of the sun and needed recruits. There follows a description of the types of fighters, the Horse-vultures, Flea-archers, Sky-gnats, and Dog-acorns, and of the battle itself, in which Lucian and his friends were taken prisoner, their hands bound with cobwebs. A complicated peace treaty was drawn up, calling for the payment of thousands



VOYAGING TO THE MOON.
*From Domingo Gonsales [A.D. 1638].*

**One fantastic 17th-century moon journey was made with birds supplying the necessary power.**

of jars of dew by the Moonites and the Sun's promise to seek no further incursion of the Moon's territory, the treaty being endorsed by the ministers Firebrace, Heaton, Nightwell, and Shimmer.

This hint that the moon voyage lends itself perfectly to a commentary on human frailty is well borne out by such poems as the *Orlando Furioso* of Ariosto (1474-1533). Astolfo, in search of the lost wits of his friend, journeys to the moon, where he finds not only what he is seeking, but also time, fame, leisure, the favors of princes, and the beauty of women. Only Folly appears to be absent, since Folly alone has never quite deserted the earth.

The great increase of moon stories in the 17th century is explained by the slow but steady spread of the new astronomy. What had once been the plaything of poet and satirist was now given new interest through those writers who considered a voyage to the moon really possible. *The Discovery of a New World: or a Discourse tending to prove that there may be another Habitable World in the Moon,* published as a serious disquisition in 1638, was later expanded by a *Discourse on the Possibility of a Passage Thither.* In the light of the long-sustained opposition to the new astronomy, it is understandable that John Wilkins spends two whole chapters of his *Discovery* in conquering his readers' prejudices. All things new, he states, are not the work of the devil; in fact, they have sometimes turned out to be for man's benefit (as witness America!). He then launches into a description of the moon's surface, through the evidence of Galileo's glass, and cautiously approaches the theory of its habitation. It has ever been the way of Providence, he states, to give us our knowledge by degrees, and spirits as eminent for new attempts as Drake, Columbus, or Daedalus, will sometime arise to undertake the new voyage. Kepler had already predicted the journey if the art of flying was ever brought about, and Wilkins now adds that as soon as man can attain a 20-mile altitude "it is not altogether improbable" that he will rise all the way.

From that time on, it was the flight itself that called for the most speculation and provoked some of the maddest guessing. Wilkins believed that body weight would be no deterrent to ascent after man had once escaped the laws of gravity; that doubtless, too, life at high altitude could be sustained on air. As for a means of navigation, it is possible, he says, that man may sometime fly

## I Claim Sirius

*Some claim the corners of the earth,*
*Some claim the central root,*
*I claim the dog-eye Sirius*
*Behind Orion's boot,*
*And mine's a claim that's oftener filled,*
*And mine's the greatest prize,*
*I need not load a single gun*
*To claim it where it lies.*

*I need not roll brown mud-slick tanks*
*Nor lay me down in mire,*
*I need not feed on power and greed*
*To get what I desire.*
*I need not look beyond my door,*
*Nor higher than my tree,*
*To claim the brightest sapphire stone*
*In the celestial sea.*

ELIZABETH JANE ASTLEY

(From "The Christian Science Monitor")

# MADNESS

*Wilson College*

by fastening the wings of birds to his own body, or by riding on the backs of giant birds properly harnessed together. In the middle of such absurdities falls what seems to us now the one sane suggestion—that a machine may sometime be made large enough "to carry diverse men at the same time together with food for their *viaticum* and commodities for traffic." "It is not," as he says, "the bigness of any thing in this kind that hinders its motion, if the motive faculty be answerable thereunto."

The century also had its moon journeys whose purpose was to ridicule the scientific imagination. Francis Godwin's *The Man in the Moon* is just such a story. Its hero, Gonzales, experiments patiently with wild swans as carriers. He uses a lamb as a test passenger, then finds that 25 birds harnessed together will bear the weight of a man. On one of these trials, Gonzales and his birds rise above the earth's gravity, flying with the swiftness of an arrow through an atmosphere which obligingly feeds them and supports them in rest. After an 11-day trip they reach the moon, the usual Utopia, with inhabitants dressed in glorious moon-colored garments and speaking a sort of accumulation of tunes.

Savinien Cyrano de Bergerac, soldier, writer of comedies, and hero of Rostand's play, in his *Histoire comique des etats et empires de la lune* and its companion piece, the *Histoire . . . du soleil*, produced an even more elaborate journey and moon society. The *Histoire* opens by pretending to be sound common sense, then sends its hero aloft, carried to the sun by nothing more complicated than very large bottles of morning dew. The traveler makes a rapid descent in Canada and has just time to rub his many bruises with marrow when lo! he is blown upward again by firecrackers, and this time, by reason of the grease, keeps on rising. At last he drops head first into an apple tree on the moon, breaking his fall by swallowing apple juice! The author, with borrowings from Lucian and his own fertile imagination, then creates another moon commonwealth where the houses, screwed down to the surface during the winter, have the ability to rise again like flowers in the spring; where one can pay for a lodging with a sonnet; and where the mark of a witty, courteous, and generous man is—an enormous nose!

With Cyrano the era of the moon journey is apparently over. The fine fervor regarding this possibility seems all but spent by the end of the century when Christian Huygens produced his *Celestial Worlds*. In this serious little treatise, the moon is at last nothing but a satellite, having mountains, yes, but no sea, rivers, clouds, nor air, and therefore only very dubiously productive of life. That the voyage has lost its reality is evident, since Huygens counts himself fortunate that he has lived beyond the time of "Fairy Stories of the Men in the Moon."

And yet, had he? The truth is that for a long time to come men were to be struck by some degree of moon madness. Their own credulousness, even in times which approach our own, continued to invite bold inventions comparable to the journalistic triumphs of Defoe. For instance, a most extravagant hoax, the "discovery of Sir John Herschel at the Cape of Good Hope,"* was given front-page space in the New York *Sun* of 1835. Although the story is not quite to our purpose, since it reports the findings of a super-telescope instead of a super-voyager, it is touched by the same fantasy that shone on Lucian. For through a lens which brought the moon to within 40 miles of the earth, Sir John was supposed to have seen the deep blue of the lunar oceans bordered by white sand and cliffs of chalk and gypsum. His big glass moved across a country of lavendar pyramids and sapphire islands, over forests where unicorns bounded about like young kittens, and creatures like human beings, with wings fitted to their backs, walked and conversed in polite groups.

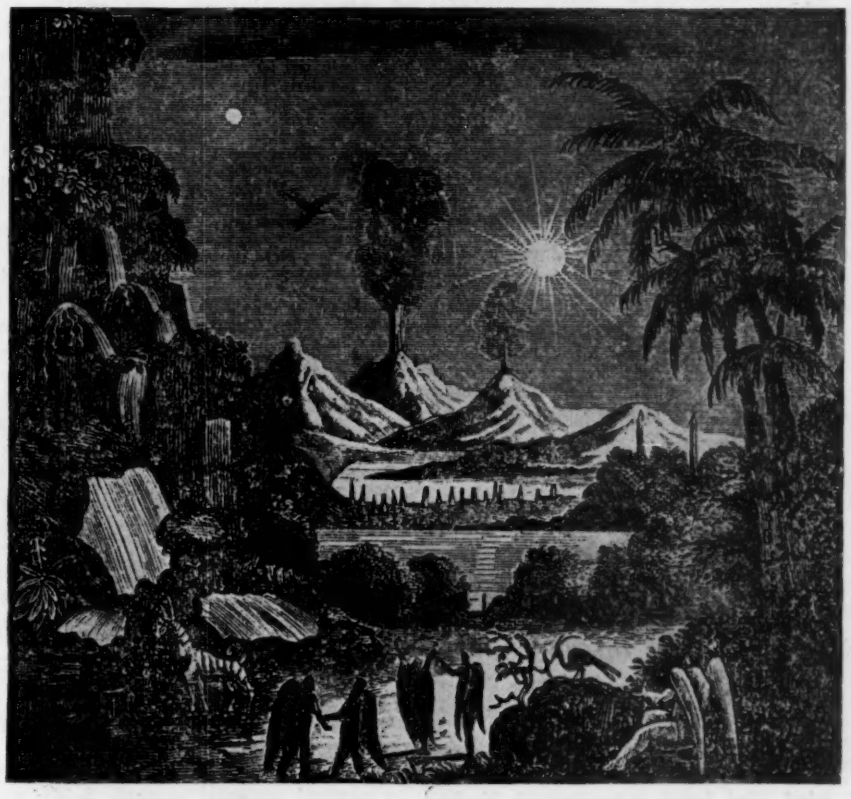
Such fantasy was accepted as serious report only a century ago and about 200 years after John Wilkins' *Discovery*. Indeed, the healthy skepticism of a 17th-century "wit" would have modified its popularity. Some such poem as Samuel Butler's *The Elephant in the Moon* would have laughed it down, a story which described the Royal Society peering through its glass at an elephant going from one end of the moon to the other.

*And every Man amaz' anew*
*How it could possibly be true*
*That any Beast should run a Race*
*So monstrous in so short a Space.*

As the learned ones solemnly debated the matter, the apprentices discovered a *mouse* in the telescope!

But, frankly, is it any wonder that the moon is a little bored with man's infinite curiosity and impertinence?

*The full text of this moon hoax appeared in The SKY, February, March, and April, 1937.



**Strange creatures and exotic scenery were common features of moon journey stories. This illustration accompanied the New York "Sun" moon hoax.**

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# BOOKS AND THE SKY

### THE ELEMENTS RAGE

**Frank W. Lane.** Country Life, Ltd., London, 1945. 188 pages. 10s. 6d.

SOME BOOKS pigeonhole as easily as an unpaid bill. It's a book for small children; it's a detective story; it's a college text; it's a book for the layman surveying modern trends in the physical sciences. But Mr. Lane has succeeded in evading any attempt at neat classification, and has produced a most enlightening mixture of meteorology, astronomy, geology, seismology, salted with quantities of geography, history, fact, and anecdote, and spiced with striking photographs.

The chapter headings give an idea of the context of the book. There are nine chapters on, respectively, hurricanes, tornadoes, waterspouts, hail, snow, lightning, meteorites, earthquakes, and volcanoes. These are, indeed, as the author says in his preface, the violent manifestations of nature. Important omissions which occur to me are floods and, considering Stewart Holbrook's entire book on **Burning an Empire**, forest fires.

In each chapter, sufficient background in the pertinent field of science is given so the phenomena may be adequately understood by a casual reader. Woven into the account are anecdotes that range over the length and breadth of the world, a vast supply of material which the average reader would be hard put to collect for himself. The author acknowledges his copious use of the writings of specialists in each field, and of more popular accounts of the eyewitness type. In the bibliography, compiled for each chapter of the book separately, appear by author the sources of material used in the chapter. As Mr. Lane has referred in his text to the names of persons to whom he is indebted for source material, use of this bibliography makes it easy for the more serious student to find for himself additional data on any topic.

Much of the bibliographical material is very recent; we find, at random, a reference to **Natural History** for June, 1944. To indicate the range of selection, another reference is to the Royal Society report on Krakatoa, dated 1888.

A straight-through reading of **The Elements Rage** may leave one rather breathless, as the facts and figures, the accounts of damage both usual and unusual, force the conclusion that nature can indeed be violent. But more peaceful interludes are provided, too, such as the discussion of Bentley's lifelong work on snow-crystal photomicrography.

There is no need to fear that because this book was written in England, it is in any way insular. American authorities are often cited, and some of the chapters (all of which were read by several experts in each field) were read by members of the U. S. Weather Bureau. Mr. Lane is careful to give both English and American numbers when citing figures in the billions, as this notation in the two countries is different, and sometimes confusing. Many of the stories are of American happenings, and while the Tay Bridge may be an unfamiliar name to us, English readers are perhaps just as unfamiliar with the name of Galveston, which most Americans know and associate with the hurricane of 1900.

Special reference must be made to the more than 50 photographs scattered through the book. They are in all cases extremely pertinent to the subject matter. They are excellently reproduced. And many of them are not of the ordinary run of photographs which one finds illustrating comparable subject matter over and over again in texts and popular books. Perhaps special note should be made of the lightning photograph, Plate 24, and of the awesome grandeur of the avalanche pictured in Plate 19. H.S.F.

### ELECTRONICS
**Today and Tomorrow**

**John Mills.** D. Van Nostrand Company, Inc., New York, 1944. 178 pages. $2.25.

"ODES TO TETRA AND PENTA" may not seem to be related to astronomy or to be of direct concern to amateur observer or telescope maker, but such hobbyists can nevertheless gain considerably from a detailed perusal of this interesting book. Tetra and Penta are top stars in a cast composed of diode, triode, tetrode, and pentode: principal varieties of electronic vacuum tubes, and servants and masters in our lives practically every instant of day and night.

Electronic enthusiasts are always talking about the day of the electron telescope, a possibility which Mr. Mills does not explore, and observers are always replying that the chief limitation on magnification of celestial objects is the distortion and dancing of the image caused by the atmosphere. If you are one to believe that rocket travel may carry our observers of the future outside the atmosphere, where an electron telescope might be usefully employed when one is invented, then perhaps you would like to have a basic understanding of present-day electronics and the operation of vacuum tubes. These are the controls, amplifiers, electron-multipliers, oscillators, rectifiers, inverters, relays, which combine to make all kinds of electrical devices function,

### NEW BOOKS RECEIVED

SCIENCE TODAY AND TOMORROW, Second Series, *Waldemar Kaempffert*, 1945, *Viking*. 279 pages. $2.75.

The science and engineering editor of the New York *Times* ranges over the length and breadth of the scientific world in a series of articles on a vast array of subjects. Some of the material is brought up-to-date from the First Series—over half of the book is new.

including controls for clock drives in modern observatories, image guiders on solar telescopes, quartz-crystal clocks at national observatories, mammoth numerical calculating machines, to mention only a few direct astronomical applications.

This book presents an introduction for the reader without previous knowledge in the field of electronics. It is entirely non-technical, in the sense that there are no formulae, no diagrams, no pictures of technical apparatus; but the author makes no attempt to avoid the terminology of the subject, and there are many pages where the going is slow if one really wishes to understand the details of operation of a certain type of vacuum tube or its application in an electrical circuit. This effort on the reader's part is amply repaid with a definite picture of just where electronics fits into scores of familiar applications.

Electronics, as the author points out, is a branch of physics, so the reader who has an elementary knowledge of physics will probably enjoy the references to names and experiments he learned of in his student days. The value of the Edison effect is described in a chapter headed "Hot Cathodes," leading directly to Fleming's valve and De Forest's audion, all forerunners of the modern vacuum tube. Here are answers to why your radio takes time to warm up, and why most radio tubes have six prongs and are pentodes, things you can check for yourself even if the "getter" inside the tube has made its walls opaque to your prying eyes.

Of special importance to astronomically minded persons are the discussions of the electron microscope, television developments and problems (but no mention is made, of course, of the recently announced Schmidt-camera design of television projectors), and the ultra-high frequencies of the future—employing wave lengths less than a meter long.

The book is written completely informally, with light asides by the author, who is a Bell Telephone Laboratories associate, and an abundance of homely metaphors, sometimes almost too many. His explanations are lucid and his comparisons sound, except in one case which we hope he omits in the next printing. In discussing resolving power of the electron microscope, he gets around to Mizar and Alcor, and then says parenthetically: "Incidentally, Mizar is itself a double star but to resolve it takes a telescope or one of those early astronomers who spotted so many binaries by unaided eye." If such men ever lived, their oculars were surely powerful!

The book may be limited in size by war restrictions, but to this reader simple diagrams would double its value, especially if the knowledge obtained is to be used in reading other electronics literature which does have diagrams. For a book of this small size, the addition of such diagrams ought not to increase the selling price. C.A.F.

## NOTES ON THE NATURE OF LIGHT

*(Continued from page 9)*

tion of the earth's motion with the other across it, and then their positions were reversed to compensate for any error in the construction of the apparatus. After many settings, Michelson and Morley reached the surprising conclusion that light went just as rapidly up and down the ether stream as across and back. This result called for some serious speculation. Either the earth must drag all the ether with it, which seems absurd as the ether must permeate the entire universe, or else there is no ether. This latter conclusion, in substance, is our stand today.

The Michelson-Morley result was "negative," within their experimental error. Other experimenters in the next 40 years confirmed this repeatedly, but in the early 1920's, Dayton C. Miller (1866-1941) carried out similar experiments and concluded that there is an ether stream, although of only a fraction of the expected velocity. Miller's result is a bone of contention today; most generally it is disregarded. A possible explanation may be found in a theory recently proposed by N. Rosen, who states in an abstract:

"It is shown possible to account for the principal results obtained by D. C. Miller's ether-drift experiment on the basis of a flat-space theory of gravitation, as due to the motion of the earth in the gravitational field of all matter and energy in the universe."

In 1887, Heinrich Hertz (1857-1894) conducted a series of experiments verifying the existence of Maxwell's electromagnetic waves. This work gave us the basis for radio transmission as we know it today. Influenced by the remarkable correlation of theory and fact, Hertz said in 1889: "The wave theory of light is from the point of view of human beings, a certainty." Later that year, Hertz' own discovery of the photoelectric effect, which we shall discuss next month, turned science from the wave theory to a new "corpuscular" theory.

*(To be continued next month)*


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*Tercentenary Papers of the Harvard Observatory* — Vol. 105 of Harvard Annals, 1937. Thirty-four papers on current astronomical researches at Harvard. Astrophysics, meteoric astronomy, photometry, and the problems of stellar distribution, variable stars, and external galaxies are about equally represented. Numerous plates, tables, diagrams, and subject bibliographies. 632 pages ..... $4.00

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# OBSERVER'S PAGE

**All times mentioned on the Observer's Page are Eastern war time.**

## Reports on Saturn's Occultation

May 14th offered little hope to the anxious astronomers in this area for observing the occultation of Saturn due to occur about sunset, because clouds and rain prevailed most of the day. However, the sun came out and the clouds rolled away about 7 o'clock.

With the sun low in the sky, Saturn was well defined in a 4-inch refractor, and Cassini's division was visible with 60x. Saturn appeared a delicate pearly color against the background of the bright sky, as the dark limb of the moon approached it a few minutes after sunset. The glare of the departed sun in the upper atmosphere made it impossible to determine the moment of first contact, but the curving line of the dark lunar rim was seen soon after it had cut into the ring of the planet.

About six minutes were required to complete the blackout of the planet, the final thread of light vanishing at second contact, timed at $8^h\ 30^m\ 43^s.0$ P.W.T. About seven minutes later the planet reappeared at the western limb of the moon very close to the upper cusp; at this station it had been occulted by only a small segment of the lunar body. Then a beautiful naked-eye view was had of the bright planet in close company with its silvery neighbor, until clouds ended the spectacle.

ROBERT E. MILLARD
Portland, Ore.

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With regard to the occultation of the moon and Saturn last night, the time of immersion here, eight miles north of the Griffith Observatory, was 8:24 flat, and emersion was at 9:13:06. The weather was ideal, perfectly clear, and the occultation was visible to naked-eye observers. My 3⅜-inch objective gave us a perfect view. TOM A. KEENE
Burbank, Cal.

---

I have just observed the occultation of Saturn tonight (May 14, 1945) and thought you might be interested in an account of it. As you know, it could only be observed in the western part of the nation and Burlingame, on the Pacific coast, is certainly west.

At the time of emersion the seeing was very poor, as usual here, and Saturn appeared an egg-shaped blur with the major axis at about 45° to the surface of the moon. The first sign of the rings emerging was at 9:07.5 p.m. P.W.T., and the last contact with the moon was at 9:08.7.

The observation was made with an 8-inch reflecting telescope using about 400x magnification and, despite the seeing, the belts on the planet were visible. I noticed a curious fact, that the belts, like the rings, were at a 45° angle to the moon, but where they almost touched the moon they were bent toward the perpendicular. This I cannot explain. JAMES BRAY
Burlingame, Cal.

---

My observing point for Saturn's occultation was particularly fortunate as the event took place only 15 minutes before nearby trees hid the moon, and thus the sun was well reduced in power. Since my short-wave radio was out of order, no attempt was made to time the contacts which were about G.C.T. $3^h\ 20^m$. I observed with an 8-inch reflector and magnification of 150. It was interesting to see the "corner" of the rings vanish, followed by the body of the planet. I made the total time for the planet proper to be 50 seconds. Owing to these same trees I was not able to see the uncovering of Saturn, and can report nothing about the line or lines upon its face mentioned in your article (May, 1945). Several of my friends hoped they might see the phenomenon "next time."

Also, on April 11, 12, 13, and 15, I demonstrated Venus passing the sun to a number of people. The youngest pair of eyes was sure he could see the complete ring of light on the 15th at G.C.T. $20^h$. HENRY POWER, M.D.
Palo Alto, Cal.

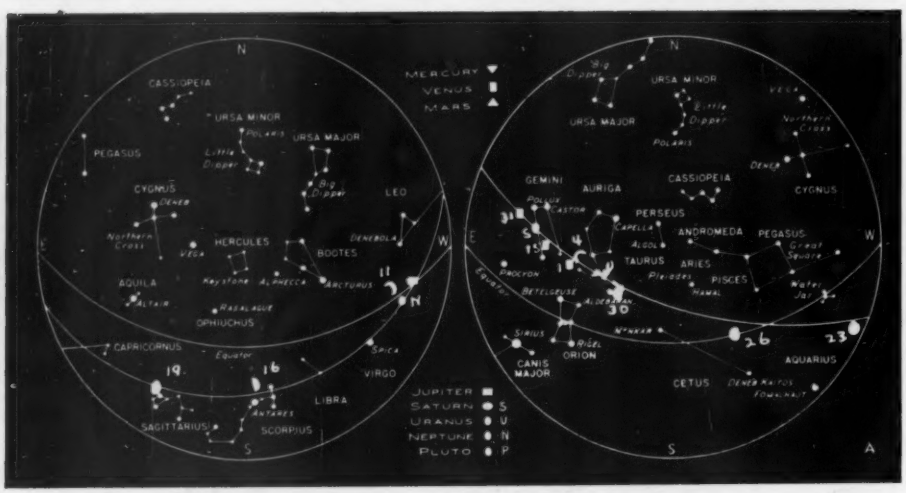
---

The occultation of Saturn on the Pacific Coast on the evening of May 14th was a beautiful sight to behold. A friend gave me a wonderful photograph of Saturn just as it came from behind the bright limb of the moon.

On the morning of June 6th, Venus, Mars, and the crescent moon formed a nearly perfect right triangle. The hypotenuse of this triangle was nearly parallel to the hills on the horizon. The following morning, June 7th, the three objects were nearly in a straight line, the moon being at the lower end, Mars at the top.

It is interesting to watch the planets and the moon travel in their courses, approaching each other and occasionally forming triangles, squares, rectangles, and trapeziums with each other and prominent stars. Lists of planetary phenomena, such as given in the **Ephemeris**, help one to check these formations in advance. FRANK TRATHEN
Napa, Cal.

## THE MOON AND PLANETS IN THE EVENING AND MORNING SKIES




**In mid-northern latitudes, the sky appears as at the right at 6:30 a.m. on the 7th of the month, and at 5:30 a.m. on the 23rd. At the left is the sky for 8:30 p.m. on the 7th and for 7:30 p.m. on the 23rd. The moon's position is given for certain dates by symbols which show roughly its phase. Each planet has a special symbol, and is located for the middle of the month, unless otherwise marked. The sun is not shown, although at times it may be above the indicated horizon. Only the brightest stars are included, and the more conspicuous constellations.**

**Mercury** sets soon after the sun in the early part of the month, and then moves into the morning sky to rise a little over an hour before the sun by the end of August.

**Venus** is in the morning sky, moving through Gemini; its magnitude is about —3.5. It is in conjunction with the moon on the 4th, and passes within a degree of Saturn on the 21st.

**Mars** rises about midnight, in Taurus. It passes 24′ south of Uranus on the 17th.

**Jupiter** is in the evening sky, moving into Virgo, but sets only one hour after the sun at the end of the month.

**Saturn** is in Gemini, in the morning sky. It is in conjunction with Venus on the 21st.

**Uranus**, in Taurus, is in conjunction with Mars on the 17th.

**Neptune** is in Virgo, too near the sun for favorable observation.

## TWO COMETS DISCOVERED IN SOUTH AFRICA

Harvard Announcement Card 709, dated June 12th, reports that D. du Toit, at Bloemfontein, South Africa, discovered a new comet of the 10th magnitude on April 9th. When news of the discovery arrived at Cambridge, the comet was not found on Harvard photographs and confirmation was requested by letter. Meanwhile the new comet had been observed continuously at both the Harvard station and the Union Observatory in South Africa.

A second radio message from Bloemfontein, in addition to reporting the continued observation, states that Dr. J. Jackson, director of the Royal Observatory at Cape Town, has computed the approximate orbit of the comet, which has now, however, become so faint as to be beyond the limit of a 10-inch photographic telescope. This comet passed through Leo and Hydra.

On June 15th, the third radiogram in this series reported discovery of a second comet by Mr. du Toit, of the 10th magnitude and located on June 11th at 1h 8m, —20°. Its daily motion was then carrying it 1m 45s west and 1° 7′ south each day.

## OCCULTATION PREDICTIONS FOR AUGUST

18-19 *1 Sagittarii* 5.1, 18:08.4 —23-42.9, 11, +67° +14° Im: *E* 5:46.6 —1.4 —1.7 111°; *F* 5:53.9′ —2.2 —2.4 130°; *G* 5:00.6 —1.6 —0.5 82°; *H* 4:55.8 —2.3 —0.6 102°; *I* 4:45.9 —1.7 0.0 83°.

24-25 *30 Piscium* 4.7, 23:59.1 —6-19.2, 17, +84° +2° Im: *E* 9:48.0 —2.5 —2.2 113°; *H* 8:44.6 —1.8 +1.0 68°. Em: *E* 10:28.7 0.0 +2.6 183°; *G* 10:18.0 —1.3 0.0 249°; *H* 10:00.4 —1.4 +1.3 225°; *I* 10:04.9 —1.5 +0.2 258°.

27-28 *85 Ceti* 6.3, 2:39.5 +10-30.5, 20, +77° —6° Em: *A* 9:09.9 —1.6 +1.0 239°; *C* 8:58.4 —1.6 +1.4 236°; *D* 8:59.8 —1.6 +0.9 252°; *E* 8:36.5 —1.7 +1.0 261°; *F* 8:12.8 —1.4 +1.4 249°; *H* 7:48.9 —1.3 +0.1 300°.

28-29 *30 B Tauri* 6.5, 3:34.7 +15-15.1, 21, +71° —7° Em: *A* 8:36.7 —1.8 +0.8 265°; *B* 8:36.8 —1.8 +0.5 275°; *C* 8:25.5 —1.7 +1.0 262°; *D* 8:25.0 —1.8 +0.6 279°; *E* 8:02.6 —1.7 +0.5 289°; *F* 7:45.8 —1.1 +0.9 274°.

30-31 *BD +21° 918* 6.3, 5:36.1 +21-44.0, 23, +71° +3° Em: *A* 11:32.2 —1.7 +1.5 239°; *C* 11:17.9 —1.6 +2.1 230°; *E* 10:59.0 —1.4 +1.6 248°; *F* 10:31.5 —0.8 —2.3 228°; *G* 10:40.1 —1.3 +0.2 308°; *H* 10:23.7 —0.7 +1.0 276°; *I* 10:28.1 —1.4 —0.4 321°.

**For selected occultations (visible at three or more stations in the U. S. and Canada under fairly favorable conditions), these predictions give: evening-morning date, star name, magnitude, right ascension in hours and minutes and declination in degrees and minutes, moon's age in days, limiting parallels of latitude, immersion or emersion; standard station designation, G.C.T., a and b quantities in minutes, position angle; the same data for each standard station westward.**

**Longitudes and latitudes of standard stations are:**

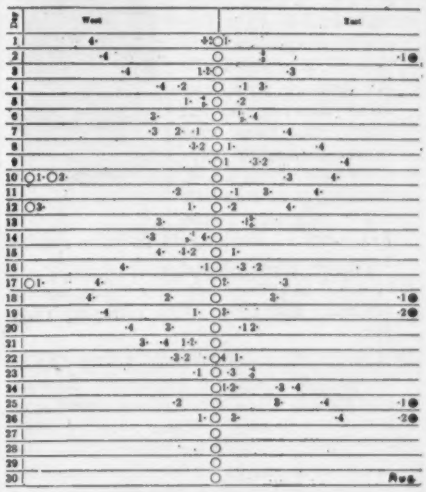
| | |
|---|---|
| **A** +72°.5, +42°.5 | **B** +73°.6, +45°.6 |
| **C** +77°.1, +38°.9 | **D** +79°.4, +43°.7 |
| **E** +91°.0, +40°.0 | **F** +98°.0, +30°.0 |
| **G** +114°.0, +50°.9 | **H** +120°.0, +36°.0 |
| **I** +123°.1 +49°.5 | |

**The a and b quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude respectively, enabling computation of fairly accurate times for one's local station (long. Lo, lat. L) within 200 or 300 miles of a standard station (long. LoS, lat. LS). Multiply a by the difference in longitude (Lo — LoS), and multiply b by the difference in latitude (L — LS), with due regard to arithmetic signs, and add both results to (or subtract from, as the case may be) the standard-station predicted time to obtain time at the local station. Then convert the Greenwich civil time to your own standard or war time.**

**For additional occultations consult the American Ephemeris and Nautical Almanac and the British Nautical Almanac, from which these predictions are taken. Texas predictions were computed by E. W. Woolard and Paul Herget.**

## JUPITER'S SATELLITES

**Jupiter's four bright moons have the positions shown below at 9:30 p.m. on the day preceding the date shown. The motion of each satellite is from the dot to the number designating it. Transits of satellites over Jupiter's disk are shown by open circles at the left, and eclipses and occultations by black disks at the right. From the American Ephemeris and Nautical Almanac.**




## PHASES OF THE MOON

New moon .....August 7, 8:32 p.m.
First quarter ....August 15, 8:26 p.m.
Full moon .....August 23, 8:03 a.m.
Last quarter .....August 29, 11:44 p.m.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

# PLANETARIUM NOTES

*Sky and Telescope* is official bulletin of the Hayden Planetarium, 81st Street and Central Park West, New York City, and of the Buhl Planetarium, Federal and West Ohio Streets, Pittsburgh, Pa.

★ **THE BUHL PLANETARIUM** presents in *August*, BY ROCKET TO THE MOON. (See page 5.)

In this production we see how the principle which has given the world revolutionary weapons in warfare may some day make possible rocket journeys through space. Boarding an imaginary rocket ship of the future, we are whisked swiftly to the moon. We explore its mountains, and the weird scenery of its craters. Highlight of the trip is an eclipse of the sun caused by the earth, which we observe fixed in the lunar sky. And a safe return journey to the earth is guaranteed.

★ **THE HAYDEN PLANETARIUM** presents in *August*, TRIP TO THE MOON. (See page 5.)

In *September*, EXPLORING THE UNIVERSE. To the man who looks only at his feet, the earth is the most important of the heavenly bodies. The man who looks out and beyond finds that his earth is astronomically insignificant—and so is his solar system. Even the Milky Way galaxy of which his sun is a tiny part is now known to be but one of many millions of galaxies. Where does the universe begin and end? What is a nebula? Are there other solar systems? As we explore through space what do we discover about the architecture of the universe?

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# GLEANINGS FOR A.T.M.s

## MAKING YOUR OWN TELESCOPE

### From Start to Finish—10

By ALLYN J. THOMPSON

**The Tripod for a Portable Mounting.** Occasionally an old surveyor's tripod, sufficiently sturdy, can be picked up secondhand, and with a few alterations, adapted for a portable mounting. Construction of a tripod is not a difficult matter. A wooden pattern for the tripod head, similar to Fig. 41, can be easily made, and a casting in iron, brass, or aluminum obtained at a local foundry. Make it 1" in thickness. Little machining is required on it. The wooden legs can be made crutchlike, as is commonly done, or of one piece as in Fig. 42. Where they are bolted to the head, brass bushings should be set into the legs and the joining bolt engaged through them, instead of bearing directly in the wood.

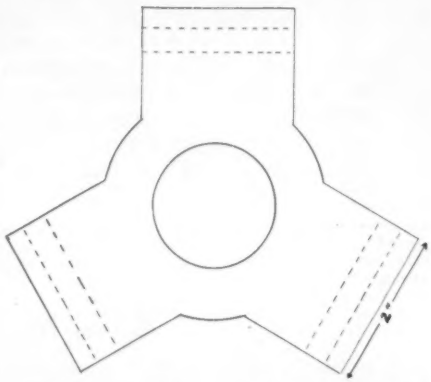

**Fig. 41. Plan for a tripod head, laid out in a 5½" circle. In a pattern, the center hole is made smaller than desired; the casting is later bored out to exact size.**

In designing the tripod, take into consideration the possibility of the tube fouling the legs when it is pointed at the zenith. Do not spread the legs wide. An angle of about 120° with the head and a leg length of about 30" may be nearly right. Fig. 47 illustrates a tripod mounting of a small reflector.

### XI—SETTING CIRCLES; EQUATORIAL ADJUSTMENT

In order that the maximum benefit may be derived from its use, the permanently mounted telescope should be in accurate equatorial adjustment and equipped with setting circles.

A ready way of procuring these is to purchase two cardboard protractors 6" in diameter. These come accurately engraved on Bristol board, with each quadrant marked from 0° to 90°, and graduated to the half degree, which is as much accuracy as we shall have use for. The protractors can be cut out and glued to plywood disks having accurately bored-out centers, varnished, and slipped over any convenient parts of the mounting. Pointers, or indicators, must likewise be attached. It is best to have the pointers attached to a stationary part of the mounting, while the circles rotate with the axes. The method of numbering on the protractors is ideally suited for the declination circle, but an alteration must be made for the hour circle. Change these quadrants to read from 0 hours to 6 hours each, one degree being equal to four minutes of time. When the circles are finally adjusted and fixed, the telescope can then be set to the exact declination and hour angle of a celestial object, which will then be found in the field of view.

The hour angle is the difference in time between the object and the observer's meridian; in other words, it is the difference between the right ascensions of the object and the meridian. The right ascension of the meridian is always equal to the local sidereal time. An example of how to convert local civil time to local sidereal time is given below.

The cardboard circles will render good service for a considerable time if protected from the weather, but the

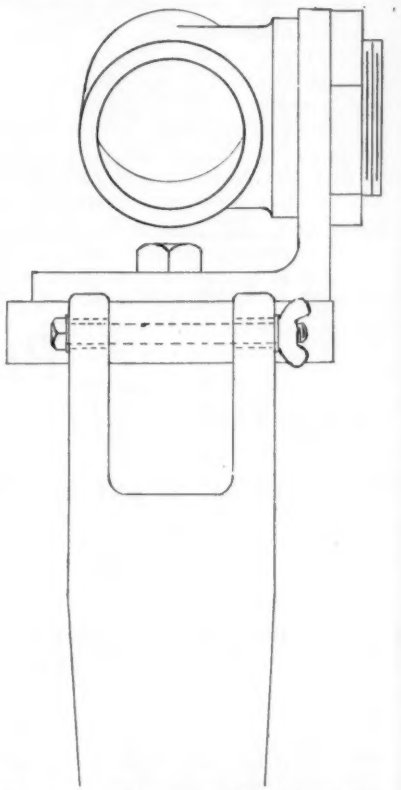

**Fig. 42. How wooden tripod legs may be attached to the casting shown in Fig. 41. This diagram also shows the manner in which the telescope in Fig. 47 is hung on an angle plate attached to the tripod head, which permits easy equatorial adjustment.**

construction of a more permanent set should be attempted at a later time. When one lacks the mechanical means of making precise graduations on metal rings or disks, the divisions can be transferred, as accurately as patience will permit, from a protractor or other graduated device onto durable plastic disks. Carefully done, with the markings cut a few thousandths of an inch wide and deep and filled with a contrasting color of paint or sealing wax, they will be both neat and serviceable. Experience with the cardboard circles may prove that half-degree graduations are not necessary. See **Sky and Telescope**, 34, 16, August, 1944, for a further discussion of cardboard and plastic protractors used as setting circles.

**Adjustments.** It is assumed that the polar and declination axes rotate in perpendicular planes. The mirror's axis must now be set perpendicular to the declination axis.

Place both the declination axis and the tube in a horizontal plane, and clamp the polar axis. Plant two stakes in the ground exactly in line with the center of the tube and on opposite sides, about 200 feet away. The stakes should be plumb in the line of sight. Look into the low-power eyepiece, and the first stake should be seen in the field of view. Swing the tube on the declination axis, through 180°, and the other stake should be seen in the field. By appropriate shimming at either end of the saddle, both stakes must be brought to the exact center of the field. Finally, use a high-power eyepiece for a more exact determination.

If sufficient ground space is not available for this test, defer alignment of the mirrors until the mounting is built, and use the empty tube, fitted with cardboard disks at each end, one disk having a 1/16" peephole exactly in its center, and the other having a ½" aperture, also centered. Plant the stakes as far away as possible, or better still, suspend plumb lines. Sighting through the peephole at first one and then the other plumb line, bring them both to the center of the ½" aperture by shimming as described. Watch out for warping of the wooden saddle after these adjustments are made.

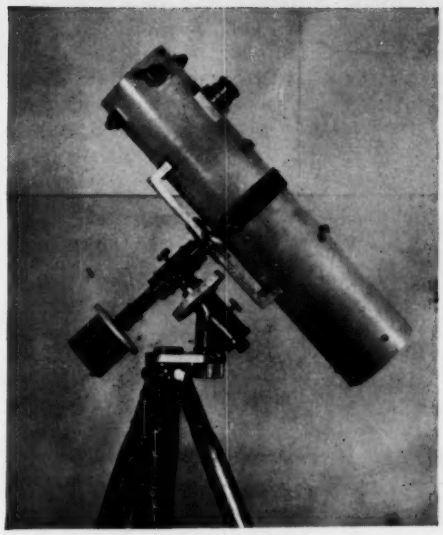

**Fig. 43. A 4¼-inch f/4.5 portable Newtonian. Note the offset, which dispenses with a counterweight on the polar axis.**

Polaris is almost exactly 1° from the celestial pole, and at the present time describes a diurnal circle of that radius about it. Twice in each 24 hours, therefore, at upper and lower **culmination**, the star is exactly north. And twice daily, at eastern and western elongation, it is at exactly the same altitude as the celestial pole. We shall first aim the polar axis true north, and later make the adjustment for altitude. Let us suppose that we are ready to begin the adjustments on the evening of May 18, 1945. The telescope is located in latitude 40° 52′ north, and longitude 73° 46′ 12″ west. Our watch is set by radio time signal to Eastern standard time, one hour slower than Eastern war time.

No amateur observer can plan observations of celestial bodies without the aid of either the **American Nautical Almanac** (price about 60 cents) or the **American Ephemeris and Nautical Almanac** (price about $2.00), published annually and for sale by the Superintendent of Documents, Washington, D. C. In what follows, we shall assume that the telescope maker has one of these books for the year 1945.

Refer to page 279 of the **Almanac** or page 554 of the **Ephemeris** and take out the following data on Polaris' upper culmination:

| | | | |
|---|---|---|---|
| May 20, G.C.T. | 9h | 53m | 56s |
| Var. in 2 days | | +07 | 50.2 |
| May 18, G.C.T. | 10 | 01 | 46.2 |
| Long. corr. 4h 55m | | | —48.0 |
| Culm. L.C.T. | 10 | 00 | 58.2 |
| Corr. stand. time | | —04 | 55.0 |
| Culm. E.S.T. | 9 | 56 | 03.2 |

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As stated in the instructions with the table, the time, $9^h\ 53^m\ 56^s$, of the transit at Greenwich on May 20th must be corrected for two days, using the variation per day given as $3^m\ 55^s.1$, giving us the Greenwich transit on May 18th. Events happen slightly later because of our longitude $4^h\ 55^m$ west of Greenwich, requiring the slight correction of 4.9 times the variation per hour of —9.8 seconds. The result is the time of culmination at our local meridian in local civil time, whereas our watch is set for the time of the 75th meridian. We are $4^m\ 55^s$ east of that meridian, so must correct our time by subtracting this amount. (The choice of a longitude produces a similarity of numbers which should not be confused with each other. The $4^h\ 55^m$ represents our distance **west** of Greenwich, and $4^m\ 55^s$ our distance **east** of the 75th [5-hour] meridian on which Eastern standard time is based.)

The result shows us that at 9:56:03.2 on the morning of May 18th, Polaris will transit our upper meridian, reaching upper culmination during the daylight hours. We shall obviously have to use lower culmination, which the same table tells us will occur 12 hours later, diminished by half the numerical value of the variation per day. Therefore, at 9:54:05.6 p.m. May 18th, Polaris will cross the meridian below the pole.

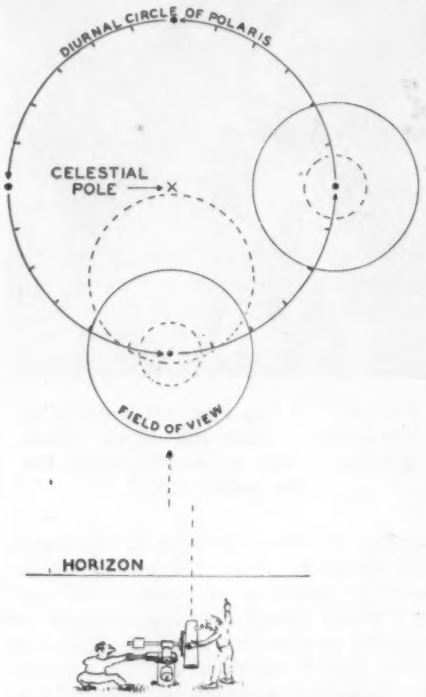


**Fig. 44. Adjusting the telescope in azimuth, which in the sketch is being done at time of lower culmination of Polaris. The distance of Polaris from the celestial pole is shown greatly exaggerated. The four small breaks in its diurnal circle (which is marked off in hours) represent 20-minute changes in its position. The field of view is the real 1° field seen with a low-power eyepiece. The small dotted circle is the comparative field of view obtained with a ½" eyepiece.**

So at about 9:30 that evening, we place the declination axis in a horizontal position and clamp the polar axis. We point the telescope northward and sweep in a vertical plane, in order to pick up Polaris, which must be brought to the center of the field by rotating the wye fitting east or west on the pier (Fig. 44). We try, as nearly as possible, to accomplish this by 9:54 p.m. Set the hour circle so that the pointer is on zero, and note the reading on the declination circle. Release the polar axis and turn it through 180° by the hour circle, so that the declination axis is again horizontal, with the telescope on the other side of the pier. Clamp the polar axis, and bring Polaris to the center of the field by sweeping in a vertical plane as before. Again note the reading on the declination circle. It is not likely that both of the readings will be the same. Now move the tube so that the declination pointer just splits the difference between the two readings, clamp it, and bring Polaris to the center of the field by tilting the mount up or down by means of the north-south lock nuts on the pier. For better accuracy, the adjustments should be completed with the aid of a high-power eyepiece.

Due to its proximity to the pole, Polaris' diurnal motion across the line of sight is slow (Fig. 44), and for completion of these preliminary adjustments a period of 20 minutes—10 minutes before and 10 minutes after the moments of culmination and elongation—may be allowed, which will not affect the final results, since the observations will have to be repeated anyway.

The polar axis now points to Polaris, which, within the interval just mentioned, is substantially due north, and 1° below the pole. A partial correction for altitude may be made by raising and lowering, respectively, the north and south lock nuts, tilting the polar axis upwards, so that Polaris is brought to the upper edge of the **inverted** field (large dotted circle, Fig. 44, inverted).

At nearly four o'clock the next morning, Polaris will be at eastern elongation, and we may indulge in a short nap, but the time of the elongation should be previously determined. The upper culmination that morning will occur at 9:52:08.1, and the last column of the Polaris table we have been using shows that elongation occurs $5^h\ 55^m.7$ earlier at our latitude. Therefore, the eastern elongation is at 3:56:26 the morning of May 19th.

At 3:30 a.m., we begin working again, setting the telescope as in Fig. 39, with the declination axis in a vertical plane, and with the tube above the pier. Clamp the polar axis and bring Polaris to the center of the field by continuing the adjustment of the north-south lock nuts. Finish up as nearly as possible to the 3:56 position, and set the declination circle to read 89 degrees.

*(To be continued. Next month, equatorial adjustment concluded; concerning atmosphere.)*

## FURTHER NOTE ON POLISHING AGENTS

Cerium oxide continues to display its superiority over rouge in the polishing of mirrors in the workshop of the A.A.A.'s Optical Division at the Hayden Planetarium. It is not unusual to bring up a complete polish on a 6-inch mirror in two hours' time. Even comparatively deep scratches, that would defy rouge, are coped with.

When the oxide is sifted between the fingers, one may become alarmed at the number of seemingly coarse particles, but apparently, in the slow hand-polishing process, these lumps disintegrate without doing any harm. In machine polishing, cerium does sometimes cause scratches and the finer Barnesite is used for the finish polishing. Cerium happened to be brought to the author's attention first, but it is hoped to give Barnesite a thorough trial before this series is concluded.

Parabolizing, however, should be attempted only with the slower working rouges; cerium works so drastically that the amateur can hardly contend with it in fine figuring. Astigmatism is the chief danger from the use of too rapid polishers. A. J. T.


## SKY-GAZERS EXCHANGE

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## ALONG THE CENTRAL LINE

(*Continued from page 4*)

command of Squadron Leader Peter M. Millman, formerly astronomer at David Dunlap Observatory, and also a small party at Churchill, on Hudson Bay.

Feverish activity continued at Bredenbury right up to the night before the eclipse, as a score of Canadian and American astronomers and physicists worked to perfect four spectrographs designed to secure flash and coronal spectra from the ultraviolet to the deep infrared, several coronal cameras, and a number of motion picture cameras. A detachment of Royal Canadian Engineers, Captain E. S. Bailey supervising, constructed mountings and piers and was assigned to assist in the operation of instruments during the eclipse. The Canadian Army provided guard and transport service.

On eclipse morning, the sun was glimpsed at sunrise in the middle of a stunning series of rainbow-hued rings, probably the result of diffraction. This unique spectacle of nature proved a bad omen, however, for the sun quickly rose into a thickening layer of altocumulus clouds. These were moving at right angles to the sun, so throughout the event the eastern and western horizons were clear, but the clouds stretched completely between them and never revealed any part of the eclipse.

NEWSPAPER stories report that several groups of observers were clouded out at Roblin, Man., some 30 miles northeast of Bredenbury. Among them were Dr. Charles H. Smiley, of Ladd Observatory, members of the Skyscrapers of Providence, R. I., and Dr. C. H. Gingrich, of Carleton College, editor of *Popular Astronomy*. These accounts state that from Roblin not one of the contacts was visible, although the sun was glimpsed shortly before totality.

Also at Roblin were T. J. Bartlett, of Dearborn Observatory; R. M. Cook, of Northwestern University; R. C. Huffer, of Beloit College; and C. F. Graham, of the Burnham Astronomical Society.

AT PINE RIVER the weather was excellent for five days, offering several expeditions there an opportunity to set up and test all equipment. Rain fell all day Sunday and the camp was a gloomy place Sunday night. At 4:00 a.m. Monday the temperature was near freezing, but there were some breaks in the clouds, and by 6:00 only a few scattered clouds remained overhead. The sky around the sun was clear until well after totality.

L. T. S. Norris-Elye, president of the Winnipeg Centre of the R.A.S.C., made the trip under the sponsorship of the Manitoba *Free Press*. He reports that there were 100 cars on the road five miles south of Pine River and at least 500 visitors.

The members of the Milwaukee Astronomical Society who based on Pine River worked in close collaboration with the Yerkes Observatory party composed of Dr. W. A. Hiltner and Dr. S. Chandrasekhar. Some of the equipment was used in common and both parties shared the same enclosure. The Yerkes astronomers took long-focus photographs of the corona, while the Milwaukee group concentrated on very precise timing of the flash spectrum, under the leadership of E. A. Halbach.

Dr. Hiltner described the corona as quite typical of the form it has during minimum sunspot activity, with short plumes or spikes extending from the sun's polar regions and long, fan-shaped equatorial streamers. Many prominences were seen, several of them quite large. Pine River observers especially noted Saturn, shining brilliantly only two degrees from the sun, while Venus was easily observed for several hours after the eclipse was over.

PREDICTIONS of possible bad weather in the lakes region came true as one group from the Milwaukee Astronomical Society, on Sandy Island in the middle of Lake Winnipeg, was clouded out. Others who flew by plane to God's Lake, halfway to Hudson Bay, fared equally badly. At Churchill, too, where two Canadian physicists observed magnetic effects, the weather was poor.

## OUTWARD FROM THE CENTRAL LINE

(*Continued from page 4*)

**Herbert Wilf, of New York City, sent in times of the first and last contacts agreeing closely with those predicted for his location. He used a stop watch of known rate set with radio time signals.**

**Manhattan Beach was the observing site chosen by Miss Valentine Erskine and her mother. Partial cloudiness prevailed and a mist covered the sun. Miss Erskine included a series of sketches of the various phases, and says further:**

**"There seemed to be no visible diminution in the daylight, but this may have been due to the mistiness of the day. About 7:40 a.m. a stiff breeze sprang up from the ocean and a woman who was passing remarked that it was colder because of the eclipse. Shortly afterward it got warmer, however, though the sun was even more obscured. We felt wonder and delight at this magnificent spectacle."**

**Shreveport, La.** Boris Weinstein named July 9th PE day, meaning Partial Eclipse day, and rose early to find the sky perfectly clear. The rising sun already had a bite out of it, and this amateur proceeded to take a series of pictures. Mr. Weinstein reports that advance newspaper accounts resulted in several thousand persons in Shreveport rising to see the eclipse.

**Winchester, Ky.** Radio reception remained excellent on all wave lengths during the partial eclipse, according to Bill Williams, of Winchester, Ky. He reports the times of the eclipse as observed through cumulus clouds; at maximum eclipse 48 per cent of the sun was obscured.

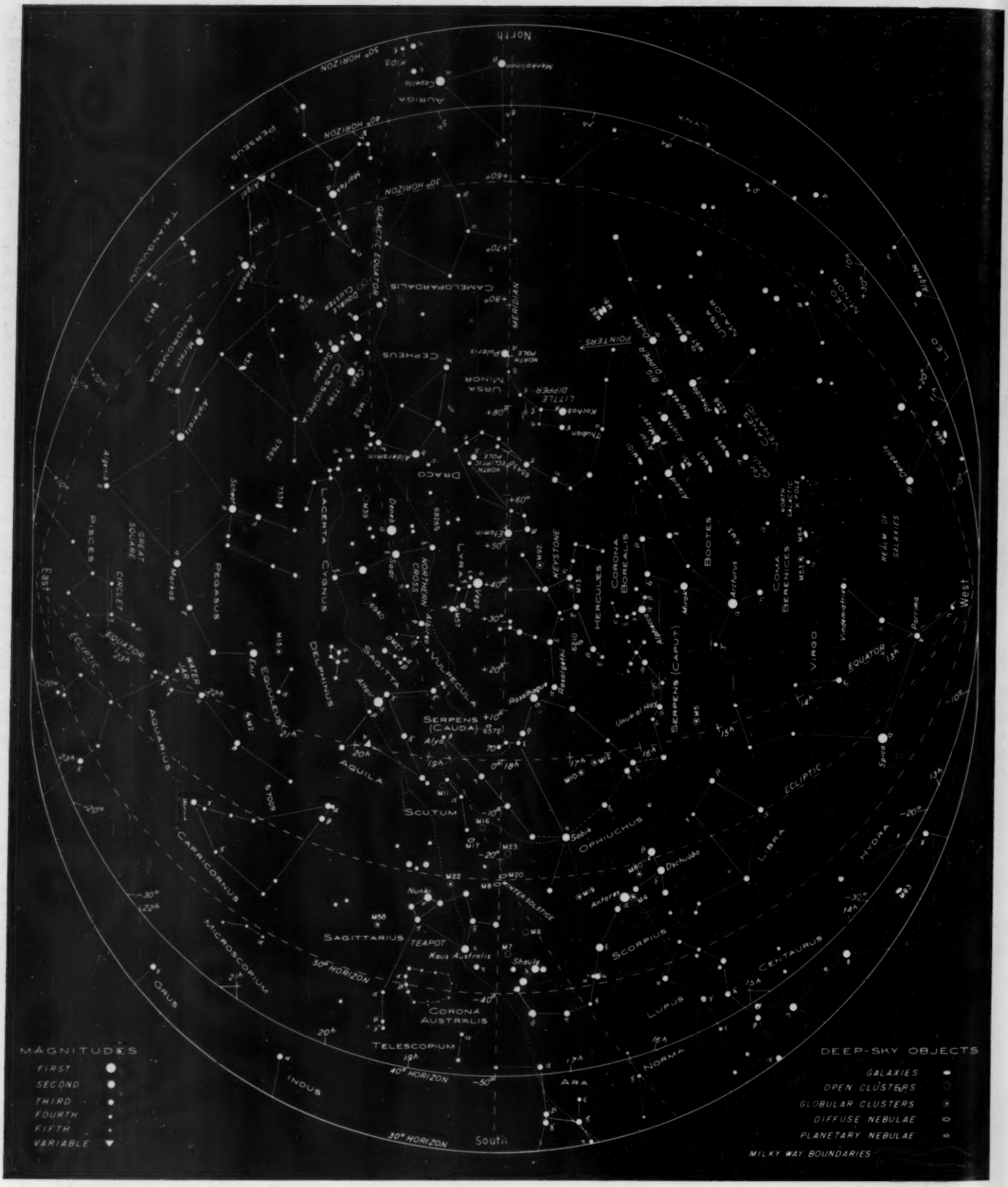
**Philadelphia, Pa.** A series of photographs of the partial eclipse was taken by Dr. George Rosengarten, a member of the Rittenhouse Astronomical Society, at his home in Brookline, Pa. He also had a 3½-inch telescope and a pinhole camera out on his lawn.

**Harlingen, Texas.** At this town, 26 miles from the Mexican border and 30 miles from the Gulf of Mexico, Louis Medlin observed with a 3-inch telescope under ideal conditions; the extent of totality was about 45 per cent.

**Florida.** At Daytona Beach, Elizabeth Lichty sketched the eclipse from her window, using dark film and opera glasses. She says: "I wish it had been total, but am thankful for this."

Ernest Rowland, Jr., president of the Jacksonville Amateur Astronomers Club, reports that 12 of the society's most active members assembled at 5:30 to prepare for sunrise an hour later. Clouds obscured first contact but they soon dispersed and the remainder of the eclipse was perfect, maximum less than 40 per cent. Mr. Rowland and G. O. Russell, secretary of the club, took pictures with a 4-inch long-focus camera stopped down to f/64; they used polarized red light at 1/200 of a second.

**The partial eclipse was photographed at Philadelphia by Dr. George Rosengarten.**




## DEEP-SKY WONDERS

AMONG marvels for observation in August skies are the objects listed here, some of which are not shown on the chart above. The informal descriptions are for common telescopes. Norton designations are in parentheses.

**Lupus.** NGC 5986, $15^h\ 42^m.4$, —37° 36′; globular.

**Scorpius.** M62, $16^h\ 57^m.8$, —30° 02′; globular. H12, $16^h\ 49^m.2$, —40° 33′; cluster of 200 stars, bright, widespread. NGC 6124, $16^h\ 18^m.8$, —40° 26′; cluster of 120 stars, also bright and widespread.

**Ophiuchus.** M9, $17^h\ 15^m.9$, —18° 28′; globular, small and dim. M14, $17^h\ 34^m.8$, —3° 13′; globular, dim, ghostly.

**Sagittarius.** M25, $18^h\ 25^m.8$, —19° 19′; cluster of 50 stars; can be seen with the unaided eye. NGC 6723, $18^h\ 55^m.8$, —36° 43′; globular. NGC 6818 (51⁴), $19^h\ 40^m$, —14° 18′; planetary, small, pale blue, slightly oval.

L. S. COPELAND

## STARS FOR AUGUST

**from latitudes 30° to 50° north, at 10 p.m. and 9 p.m., war time, on the 7th and 23rd of the month, respectively. The 40° north horizon is a solid circle; the others are circles, too, but dashed in part. When facing north, hold "North" at the bottom, and similarly for other directions. This is a stereographic projection, in which the flattened appearance of the sky itself is closely reproduced, without distortion.**

# SIR WILLIAM HERSCHEL

*He borrowed a* TELESCOPE *and revolutionized* ASTRONOMY

IN 1772, William Herschel, music teacher of Bath and son of a Hanoverian bandmaster, borrowed a 2-ft. Gregorian telescope for some casual star-gazing. Fascinated by what he saw and unable to buy a telescope, he decided to make one.

Study of Smith's "Harmonies and Optics" and Ferguson's "Astronomy" and hard work casting and polishing specula resulted after several years in a 5-ft., a 7-ft. and even longer instruments.

### HE DISCOVERED URANUS

Through his 7-ft. telescope, he discovered "Georgium Sidus" (Uranus) in 1781. Herschel carried figuring of his mirrors far beyond those of his predecessors and demonstrated the value of aperture to definition and grasp of light. Recognized as the link between the old and new astronomy, he won knighthood and the perpetuation of his name in the Herschelian "front view" telescope.

### PURSUIT OF PERFECTION

Men of science like Herschel and his modern disciples have always set perfection as their goal. Working with such men in Industry, Education and the Armed Forces has been a challenge to Perkin-Elmer to supply them with the finest in optical instruments, lenses, prisms and other optical elements.

To the experience and skill that won recognition for Perkin-Elmer before the war has now been added the knowledge and experience gained in *mass-producing* its most accurate products for war industries and the armed forces. This combination promises much for the optical instruments, devices and elements which Perkin-Elmer will produce to bring even greater accuracy to analysis, control, inspection and observation in *postwar* applications.

### WHAT PERKIN-ELMER MAKES

*Perkin-Elmer serves the optical sciences that broaden man's horizons* by supplying them with:

Custom-built optical instruments for industrial analysis, control, and inspection.

New optical devices to solve specific problems.

Special elements such as fine lenses, prisms, mirrors, flats, photographic objectives, interferometer plates, retardation plates, Cornu prisms, Rochon prisms, and Nicol prisms.

Perkin-Elmer is now 100% in war work, but after the war will resume manufacture of such peace-time products as Schmidt cameras, refracting and reflecting telescopes, equatorial mountings, oculars, direct-vision prisms, polarizing eye pieces, and other equipment.

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